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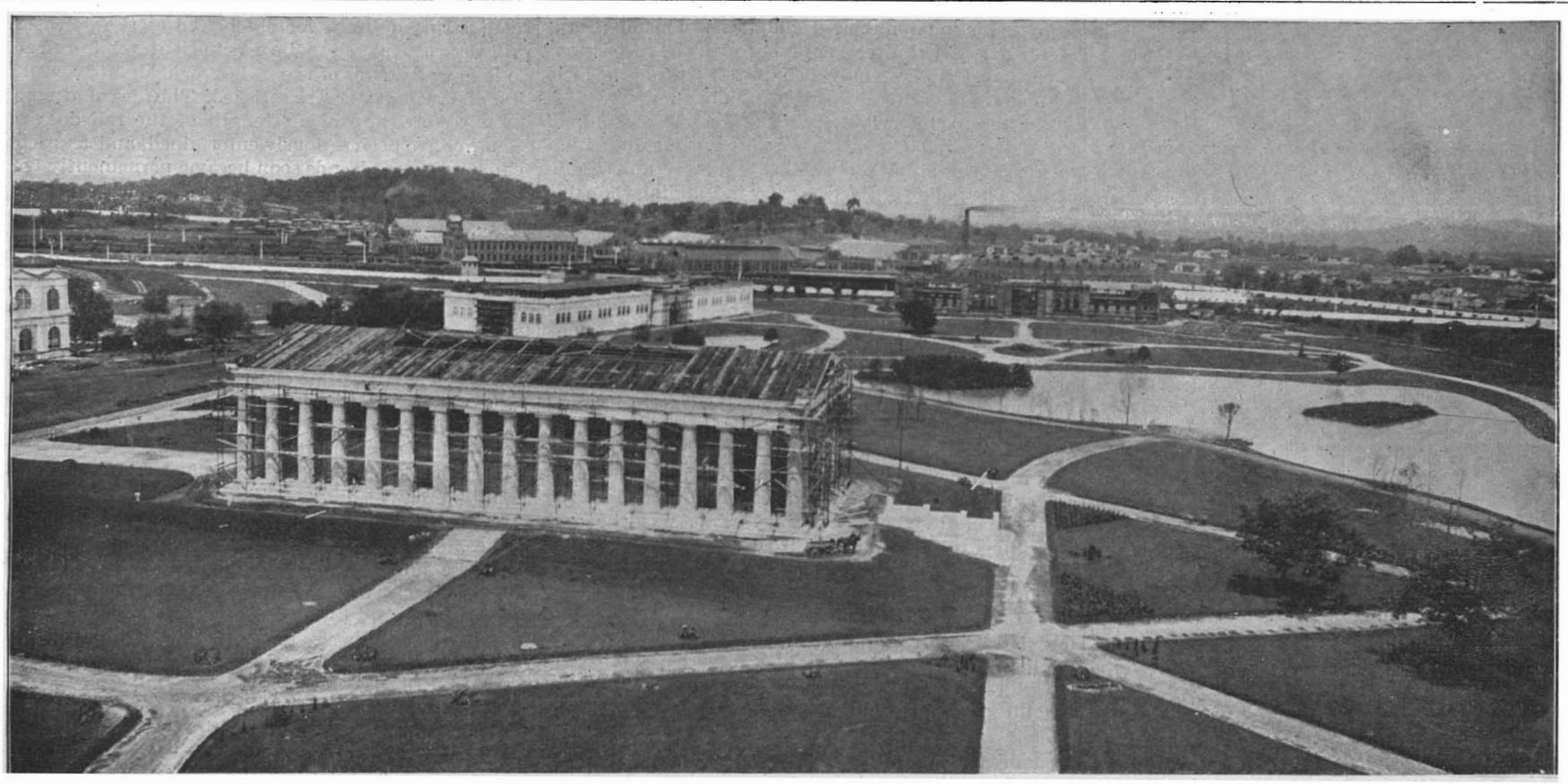

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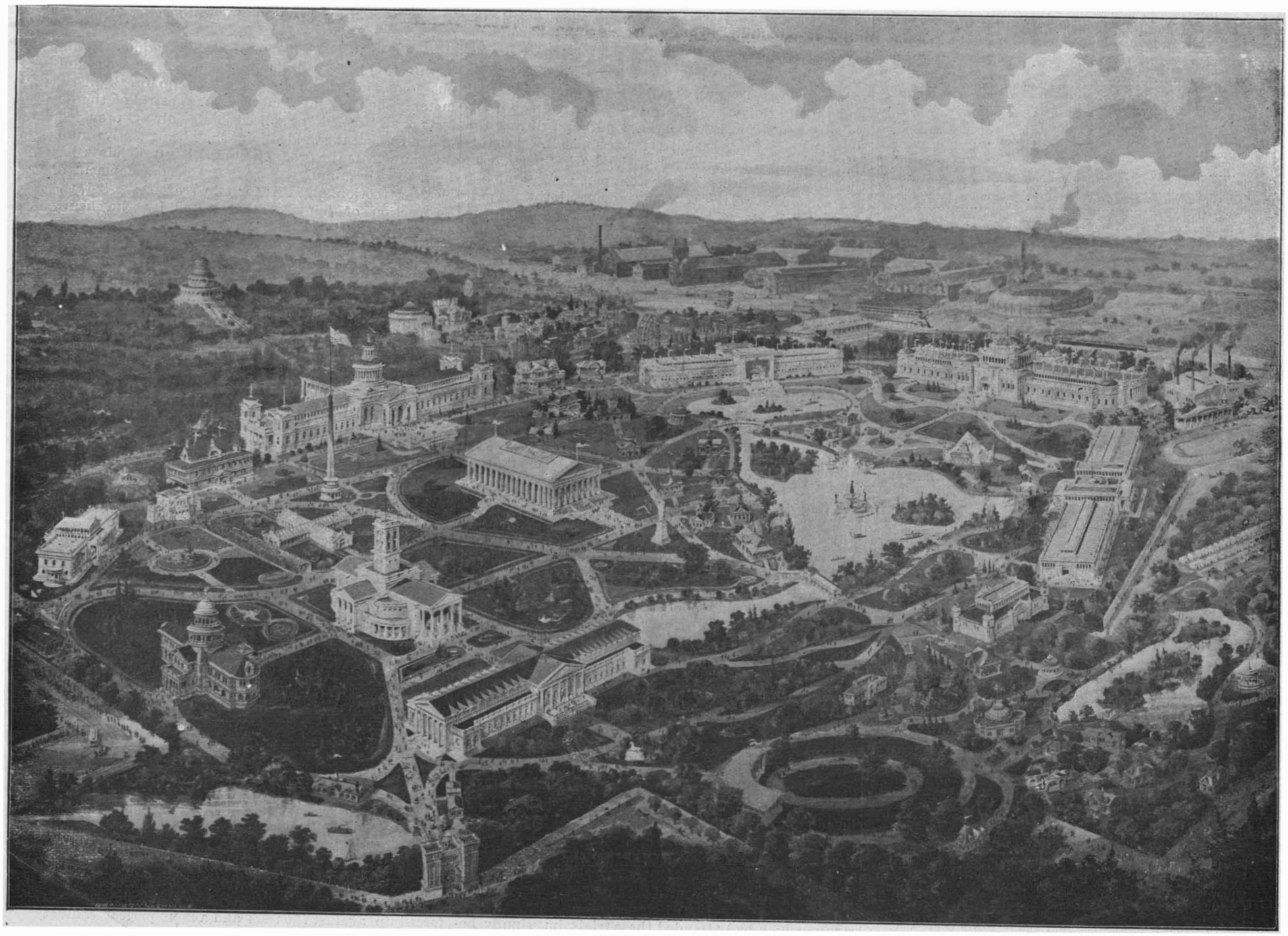

THE TENNESSEE CENTENNIAL EXPOSITION, NASHVILLE, 1897—BIRD'S EYE VIEW.—[See page 36.]

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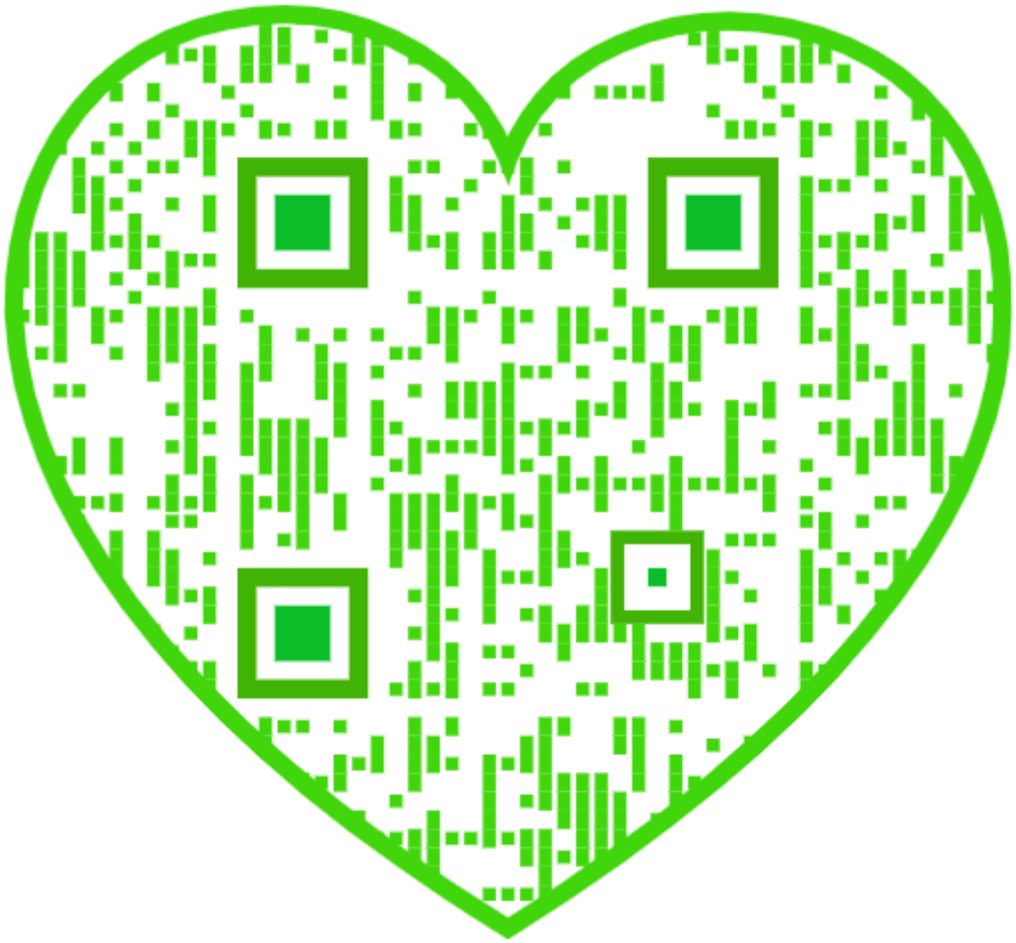

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COMPETITIVE SYSTEMS OF TRACTION IN NEW YORK CITY.

There is probably no city in the world where so good an opportunity is presented for a comparative test of the merits of the various systems of street traction as that which is offered on the lines of the Metropolitan Traction Company, New York. In addition to its world renowned Broadway cable line, which carries by far the heaviest traffic of any cable road in existence, the company operates some miles of electric underground trolley road on Lenox Avenue, upon which also it is running experimentally some compressed air motors built on the Hoadley patents. The fierce competition between the surface and elevated roads of the city is favorable to an unbiased judgment of results; for it is safe to say that after complying with the restrictions of the law, that system which proves to be the most economical and effective will be finally adopted.

In a recent interview with President Vreeland, of the Metropolitan Company, we were given certain facts regarding the situation which are timely and significant. The policy of the company in building the cable road on Broadway, and its later extension on Lexington Avenue, and also the proposed underground trolley lines on Eighth and Sixth Avenues, has been determined by the exigencies of an ever increasing and overburdened traffic. So rapid has been the growth of travel in New York City that there has never been a time when it has not exceeded the capacity of the company's roads. Extensions and improvements have been made under the spur of pressing necessity, and the company has never been able to afford the time necessary for any lengthy experimental work of its own to determine the best form of traction. In all contemplated improvements it has had to choose the best system in sight at the time. This was the case when the cable was chosen for Broadway, and it is the same pressing necessity that causes the company to put in the costly underground trolley on forty-three miles of its lines on Eighth and Madison Avenues, before its experimental work with the compressed air motors is completed.

With regard to the cable road, the company is satisfied that in spite of the high state of efficiency to which electric traction has been brought and its superior economy under average conditions the cable is the best form of traction for the exceptionally heavy traffic on Broadway. The fact that electricity is replacing the cable in San Francisco and elsewhere, and showing a higher comparative economy, proves the case only for such conditions as obtain on these lines, where the volume of travel is moderate and the headway between cars is measured by minutes. The Broadway cable road, however, is operated under conditions that find no parallel in any city of the world. The average headway between cars is twenty seconds, and during the "rush" hours it is as small as ten seconds. Add to this that the bulk of the travel on the busiest portions of the line is local, necessitating frequent stops, and one has some idea of the enormous demand that is put upon the power house, and the value of having at command the great reservoir of momentum which is provided by the cable and its miles of moving cars. The problem of transportation on a line where the headway is measured by seconds instead of by minutes resolves itself largely into one of celerity in starting and stopping, and the management and engineers of the Broadway line are satisfied that this is more efficiently solved by the existing cable than it could be by any form of electric traction.

That the company considers this efficiency to hold good only where the burden of traffic is abnormally heavy is proved by its intention to equip the parallel lines on Eighth and Madison Avenues electrically. These lines are at present operated by horse cars, and the change is being made chiefly with a view of relieving the congestion on Broadway, and incidentally to provide a better service on these lines. The change will affect forty-three miles of road. The Eighth Avenue line will extend from One Hundred and Fifty-third Street to Fifty-ninth and thence by way of Sixth Avenue to a terminus at the lower end of the city. The Madison Avenue line will extend from One Hundred and Thirty-eighth Street to the Post Office by way of Fourth Avenue, the Bowery and Center Street. The construction and equipment will be similar to that which is used on the Lenox Avenue line, an illustrated description which was given in the SCIENTIFIC AMERICAN of February 22, 1896. Power for the Madison Avenue line will be furnished from the Twenty-fifth Street power house, in which will be erected four 850 kilowatt generators, driven by direct connected engines of 1,300 horse power. At the One Hundred and Forty-sixth Street station three 850 kilowatt generators will be added to the two 400 kilowatt generators which are already in place.

With reference to the experiments in compressed air traction which the company is carrying out on Lenox Avenue, we are informed that electricity was not chosen for the new lines because of any unfavorable results which had attended these trials, but simply because the experiments had not extended over a sufficient period to allow any reliable data to be tabulated. The results have so far been satisfactory, and two more motors will soon be added to the equipment. The company still has over one hundred miles of horse car lines which have yet to be changed to some form of mechanical traction, and if the compressed air motors fulfill their present promise after a sufficiently lengthy trial, they will probably in time be placed on a portion of these lines.

WELDED RAIL JOINTS.

There is certainly no part of the roadbed of steam railroads that has received more careful attention of late years than the rail joints. Time was when these were the most neglected portion of the track, and two small strips of iron, loosely bolted to the web of the rail, were considered to be a sufficient reinforcement. So long as the ends of the rail were held fairly well in line, the roadmaster was satisfied. The idea of attempting to restore the whole strength of the rail does not seem to have been seriously entertained, and as a consequence the rail ends soon became permanently bent under the incessant pounding of the traffic, and every joint became a hollow spot, lying more or less below the track level. To-day, however, the engineer has changed all that. By designing the joints on scientific principles, giving them a section adapted to the strains which they have to endure, it has been possible to produce a length of track whose vertical stiffness and strength are continuous, the joints displaying these qualities as fully as the body of the rail itself.

Such, at least, is the condition of first-class modern track when it is first laid. Laboratory tests have shown that some of the modern joints possess even greater rigidity than the rail itself, at least under the conditions of test where the load is applied as a static pressure, and has no dynamic effect. Conditions of service, however, are so entirely different that it can easily be understood that the results fall far below those which are obtained in the testing machine. The loads, represented by the weight of the train concentrated on the wheels, come upon the joints with the dynamic effect of a blow, the bending effect of which is far greater than would be due to the quiet load. The tendency of this pounding is to loosen the fastenings and allow movement and wear of the parts, with the ultimate result that no amount of screwing up will take out the "sag," and keep the joint up to level. Although it is true that by increasing the weight of rails and fastenings these difficulties are reduced, yet in the best of track the joints still remain the chief source of care and expense.

In view of this fact, it is natural that engineers should be directing their energies to the design of a continuous joint, in which there shall be no break in the metal. Such a joint would at once get rid of the defects of all "fished" or spliced joints—always provided, of course, that the welded joint shall be perfectly sound.

Of late years the production of better rail joints has been greatly stimulated by the rapid development of electric traction, and this for two reasons: First, the destruction of joints was increased by the heavy pounding of rigidly supported motors (a difficulty which the partial supporting of the motors on springs has merely reduced, but has not removed); and secondly, the desire to secure the greatest possible electrical conductivity has directed attention to welded joints.

The first efforts to secure a continuous metallic joint were made by electrical welding, and this was followed by what is known as cast welding. In the first case a powerful electric current is passed through the ends of the rails and pieces of iron, known as chucks, which take the place of the fishplates. When the metal has been raised to a welding heat, heavy pressure is brought against the side plates and they are welded to the rails, the flow of metal filling in the space between the rail ends and forming a butt weld. It is claimed, and justly so, that a perfectly welded joint is stronger than the body of the rail. In cast welding, molten cast iron is run into a mould which incloses the abutting rail ends, which are thereby heated (or are supposed to be) to the welding point, so that the resulting joint is solid and continuous.

Mr. W. K. Bowen, superintendent of the Chicago City Road, has recently given some data in a paper before the convention of the American Street Railway Association, at St. Louis, which promise well for this style of joint. He stated that, of the 17,000 cast welded joints made on his road in 1895, only 154 were lost, and these breakages were due to flaws in the metal. Comparative tests have shown the joint to be "far stronger than the rail itself." The joints are made as follows: After the rail ends have been scraped or filed off so as to present a bright surface, a cast iron mould is placed around the joint, the fit being made so snug as to prevent the escape of any metal from the mould.

The metal is then poured in, and the outer part of the casting, being chilled by the mould, sets first, forming a crust which retains the molten metal. As this crust contracts faster than the interior, the latter is forced up against the rails and a more perfect contact is insured.

Although the first object of electrical engineers in

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making welded joints, electrical or cast, was to secure better electrical conductivity, as a matter of fact the mechanical advantages of this style of joint are of scarcely less importance. The strength of a bolted joint is entirely dependent on its fastenings being tightly held in place; and the construction of city tracks is such that these fastenings are often beyond the reach of the trackman's wrench. However well they may be secured when the track is laid, they soon slack up under the pounding of the traffic. This fact will account for the noisiness of street as compared with main line track. The welded joint requires no attention and may be covered up by the street paving with impunity.

As to the question of expansion and contraction of the rails due to change of temperature, it was proved in an experimental test at Johnstown, a few years ago, and in subsequent tests, that the elasticity of the steel is capable of accommodating such changes of length as take place. It should be noted in conclusion, however, that a continuously welded track, to be safe from distortion, must be exceptionally well spiked to the ties, and the ties and ballast must be of first class quality.

The Latest Plan of Rapid Transit for New York City.

The plan of rapid transit adopted by the Commission at its last meeting shows important modifications of the proposals recently made by the chief engineer. The reason for the changes, as stated by the president of the Commission, Alexander E. Orr, is that the main object of any proposed railway must be to secure really rapid transportation between the northerly and southerly portions of the city, and to obtain this requires the running of express trains and the consequent construction of a four-track railroad. While a three-track road permits the running of express trains at certain hours of the day, a two-track road in a city must be run solely as a local road. It follows that, if two two-track railroads were constructed north of Forty-second Street, the one east and the other west of Central Park, as originally proposed, the scheme would entirely fail in furnishing rapid transit to the district to the north.

The amended route is as follows: A two-track road starting from a loop at South Ferry and running beneath Broadway as far as Chambers Street. From Chambers Street and City Hall Park, where another loop would be constructed, a four-track underground road would be run beneath Elm Street and Fourth Avenue to Forty-second Street; thence westerly, under Forty-second Street, to Broadway; thence northerly under Broadway and the Boulevard to One Hundred and Fourth Street. At One Hundred and Fourth Street the road will divide into two two-track branches, the westerly branch continuing to the north under the Boulevard, Eleventh Avenue, Elmwood Street and Broadway, to a point in Kingsbridge immediately north of the Harlem River, where connection could be made with existing surface roads running north. The easterly branch from One Hundred and Fourth Street and the Boulevard would run in a northeasterly direction beneath private property, One Hundred and Sixth Street and Central Park, to Lenox Avenue; thence northerly beneath Lenox Avenue to the Harlem River, beneath which it would be carried by a tunnel. From the Harlem River the line would be carried to Bronx Park.

The west side line would be underground from the Battery to One Hundred and Ninetieth Street, except across Manhattan valley. The easterly branch would also be underground from One Hundred and Fourth Street, beneath the Harlem River, to a point east of Third Avenue, beyond which an elevated road would be built.

The estimated cost is somewhat less than $35,000,000, and the Commissioners are of the opinion that, while such a system would not be complete, it would soon demonstrate its success, and would ultimately be supplemented by say a branch from Forty-second Street to Fourteenth Street, and another branch on the east side of Central Park, from Forty-second Street to One Hundred and Tenth Street, to connect with the present proposed route.

Taken altogether, the revision of the original plans shows good judgment and is warranted by the city's experience with the existing roads.

The substitution of a four-track for two two-track roads from Forty-second Street to One Hundred and Fourth Street, with a view to securing unobstructed tracks for express service, is well made, for the new scheme must give an accelerated service if it is to secure popular approval. The Commissioners have also supplied an important missing link in the original plans, by including a two-track underground from South Ferry to City Hall Park.

THE wave length of Roentgen rays has been ascertained by Dr. Fromm, of Munich, at fourteen millionths of a millimeter, that is about seventy-five times smaller than the smallest wave length for light. This determination was based upon interference phenomena observed by Dr. Fromm, says Prometheus.

The Rheinfelden Hydraulic Power Plant.

Most American tourists who cross the ocean every year to pay a visit to the Continent know that part of the Rhine which forms the frontier between Switzerland and the Black Forest, that is, the part between the picturesque Falls of Schaffhausen and the ancient city of Basle. Many of the visitors may also remember the rapids over which the Rhine rolls its foaming waters near the little town of Rheinfelden, near Basle. This quiet and pretty little town has now got quite a lively aspect, since a work has been commenced in its immediate neighborhood which is destined to change the whole surrounding country. Some enterprising men, among whom are some of the leading engineers and financiers of Germany and Switzerland, had, a couple of years ago, formed a company for the utilization of the water power of the Rhine, and as there was no difficulty in obtaining the concession from the two adjoining countries, a well known engineer, Prof. Zschokke, of the Zurich Polytechnic School, was intrusted with the execution of a work which, on completion, will be the largest of its kind in Europe. In short, once more nature is to be made serviceable to man, and the considerable quantity of water (on an average 12,400 cubic feet a second) which the Rhine carries over the rapids of Rheinfelden will be brought to yield some 30,000 horse power, to be transmitted as electrical energy to industrial establishments within a radius of twenty miles.

The first part of the work is nearly finished, and it is expected that before next autumn 16,800 horse power will be available. To obtain this force a canal had to be constructed five-eighths of a mile in length and 165 feet wide, which is partly built in the bed of the river, and is separated from the river proper by a wall from 33 to 39 feet in height, with a width of 15 feet at the foundation. This wall alone absorbed some 23,550 cubic meters of solid rock, mostly excavated from the bed of the river, which, with innumerable mines, had to be deepened considerably at the lower end of the canal, so as to allow the water to flow away easily after having passed the turbines

At the lower end of the canal, standing diagonally across it, we find the building which contains the twenty turbines, all manufactured by the well known firm of Escher, Wyss & Company, of Zurich, and each of which has a capacity of 840 horse power. The same building contains the electrical machinery which produces the current. These engines are constructed partly by the famous "General Electric Company," of Berlin, and partly by the "Manufactory of Oerlikon," near Zurich.

By means of an iron bridge the works, which are situated on the German side of the river, are connected with the Swiss side. This bridge also carries the numerous cables which are to transfer the electric energy to the various industrial centers in Switzerland. The whole of the network is to cover some 315 miles. More than half of the available energy is already disposed of to industrial enterprises, which have come to establish themselves at Rheinfelden in order to take advantage of the exceptionally cheap motive power, the prices for which rank considerably below those of steam. Some large electro-chemical factories are now in course of construction, which will be manufacturing aluminum, chlorine, soda and calcium carbide. Several railway lines are also being built now in order to connect the large territories belonging to the company with two of the principal railways of Germany and Switzerland. In fact, to look at the activity displayed round the electric works of Rheinfelden, where hundreds of workmen are busy building and constructing, the casual visitor would hardly recognize the quiet old town on the Rhine.

Death of General Francis A. Walker.

General Francis A. Walker, President of the Massachusetts Institute of Technology, died suddenly at his residence in Boston, on January 5. General Walker was born in 1840. He graduated from Amherst College in 1860 and then studied law. When the war broke out he enlisted as sergeant major in the Fifteenth Massachusetts regiment and was rapidly promoted. He was captured at Reams Station and kept for some time in Libby prison. At the close of the war General Walker taught classics and tried journalism. In 1869 he was appointed chief of the Bureau of Statistics at Washington, and a year later organized and conducted the Ninth Census. His executive ability was seen and recognized and some of the best features in the Bureau of Statistics date from General Walker's incumbency as chief. In 1871 he became United States Commissioner of Indian Affairs, and in 1873 Professor of Political Economy at the Sheffield Scientific School at New Haven. In 1876 he was chief of the Bureau of Awards at the Centennial Exhibition. In 1879 he organized the Tenth Census, and in 1881 he became president of the Massachusetts Institute of Technology.

General Walker attained by his many writings and lectures a great reputation as a political economist. Notwithstanding these various interests General Walker devoted the bulk of his time to the Institute of Technology since he became its president, and his wonderful faculty for organization resulted in a continuous expansion of the work of the institution, until it is now in the front ranks of American scientific schools. As an educator, General Walker will be sorely missed.

A Suggestion for Laying Gas Pipes.

Those of our readers who have undergone the vexation of having their lawns cut up and more or less disfigured by the process of pipe laying will find the method adopted by Mr. Charles Lurcott, an employe of long standing in the office of the SCIENTIFIC AMERICAN, of practical interest. Mr. Lurcott was desirous of putting in the gas in his amateur workshop, which is 24 feet distant from the house. To avoid digging the customary trench across the lawn, and the permanent disfigurement which follows, he determined to bore a hole through the soil from the cellar to a point below the floor of the shop. The boring apparatus was extemporized out of a piece of $\frac{5}{16}$ inch flat iron, a $\frac{3}{4}$ inch bar, some 6 foot lengths of piping and a carpenter's brace. The flat iron, $\frac{5}{16}$ by 1 inch and 2 feet long, was bent cold with a twist of half a turn in 6 inches at one end, the other end being scarfed and riveted to a 6 foot length of $\frac{3}{4}$ inch round iron. The opposite end of the $\frac{3}{4}$ inch iron was threaded into a $\frac{3}{8}$ inch pipe coupling, and with the addition of three 6 foot lengths of $\frac{3}{8}$ inch pipe and couplings, the apparatus was complete. To connect the carpenter's brace with each piece of pipe as the boring proceeded, a short length of $\frac{1}{4}$ inch pipe was screwed into a $\frac{3}{8}$ inch cap, its other end being filed square so as to enter the brace. With this simple and cheap boring machine completed, all that was necessary was to remove a stone in the cellar wall and commence boring. The auger cut its way readily through the soil, and in just 15 minutes a hole large enough for a $\frac{1}{2}$ inch gas pipe was made for the required distance of 24 feet. The auger cut its way without any tendency to swerve out of line, and had any rocks been encountered, it would have been easy to dig down and remove them.

It should be added that the ground at the time was frozen and covered with several inches of snow, and anyone who has had to dig a trench under such circumstances will appreciate the saving of labor attending the methods of pipe laying employed by Mr. Lurcott.

A Large Waterfall.

A special dispatch from St. Paul, Minn., says that the following letter has been received from S. A. Thompson, at Santa Catalina, Venezuela:

"During the exploration of the concession of the Orinoco Company, headed by Donald Grant and other Minnesota men, a trail was cut to the Imataca Mountains, starting from this point, a village of 150 inhabitants. The duties assigned to some members of the party kept them upon or close to the Orinoco until a few weeks ago, when two of us, Leslie O. Dart, of Litchfield, Minn., and myself, of Duluth, found time to make an excursion to the mountains.

"Pushing on beyond the point reached by the other party, we heard from the top of a mountain a sound which at first we thought to be thunder, but afterward decided that it must come from a waterfall of considerable magnitude. Working in the general direction of the sound over a difficult trail, we came, at noon on Thursday, October 15, to a large river, and discovered what must rank as one of the greatest waterfalls in the world.

"The river bursts diagonally through an almost perpendicular cliff, which I estimate to be 1,600 feet in height, breaks into half a dozen separate streams, which divide and subdivide, spread out into broad, fanlike expansions, and twist about in such a curious, corkscrew fashion, that the water at the bottom of the falls flows in exactly the opposite direction from the course it holds where it first comes into view.

"By clinging to bushes and going up the giant creepers hand over hand, we climbed up the cliff until the aneroid indicated an elevation of more than 500 feet, but it was impossible to reach the top and learn how much higher the falls are."

Rich Lands in the Far North.

Mr. Tyrell, of the Geological Survey Department, has arrived at Winnipeg, bound for Ottawa, and reports having discovered rich tracts of agricultural and stock raising country hitherto unknown. He left Selkirk on January 24. From Norway House he descended the Nelson River in a canoe to the Pine River, ascending it to Wolf River. Again the Nelson was descended for seventy-five miles, until the Brentwood River was reached, thence down the Grassy River to the Sturgeon, which brought them to the Saskatchewan at Cumberland House. Recently they reached Prince Albert. Mr. Tyrell says that there are large areas of rich, cultivable lands west of the Nelson River, and though wheat is not grown, simply because it would be of no value, all varieties of vegetables are produced in the gardens of the Hudson Bay Company posts, and prove hardy. Except for the climate, he declares that that country is as richly blessed as the famed Red River valley.

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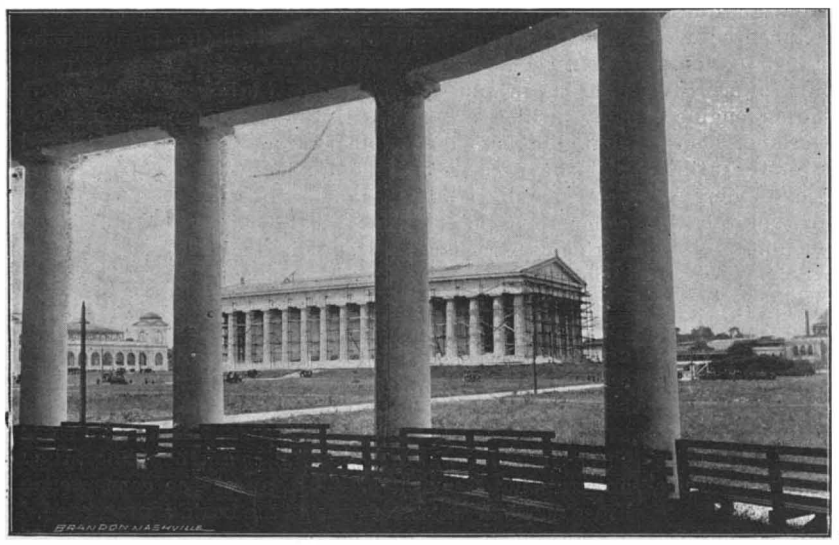
THE TENNESSEE CENTENNIAL EXPOSITION.

Since the Chicago World's Fair, of 1893, there have been expositions held somewhere in the United States every year, with one exception, the California Midwinter Exposition and the International Cotton States Exposition following each other in quick succession, and now the present year is to witness what the indomitable energy of a single State can accomplish. Tennessee will hold what will be called the "Tennessee Centennial and International Exposition" at Nashville. The date of the opening of the Exposition is May 1 and that of the closing October 31. The occasion of the Exposition is the one hundredth anniversary of the admission of Tennessee as a State into the Union. It is very creditable that this progressive State should express its gratitude to the founders of the commonwealth in such an eminently patriotic manner. Tennessee is the first State in the Union to so celebrate the one hundredth anniversary of her statehood, and the interest which has been evinced by all sections of the country shows that the celebration will be of national importance. It is not intended to run the Exposition as a money making scheme, as it is largely prompted by sentiment, and the grave defects in the management of all the American expositions since and including the Chicago World's Fair have been carefully guarded against. President Cleveland has signed the bill appropriating $130,000 for the erection of a suitable building to contain the government exhibits; so that the success of the Exposition seems now assured. Many of the Exposition buildings are already finished and nearly all will be ready to receive exhibits by March 1; so that there is very little chance of any delay in the opening of the Exposition.

Shortly after June 1, 1894, a company was organized, a charter was secured and stock was issued. Notwithstanding the fact that the Exposition was arranged for at a time of great financial stringency, the money necessary to guarantee the success of the Exposition was forthcoming. As was the case with the Chicago World's Fair, it was found impossible to finish the work in time to allow of opening the Exposition on June 1, 1896; so, following the precedent set by the World's Fair, the grounds were dedicated with appropriate ceremonies on the anniversary and the opening of the Exposition itself was postponed for one year.

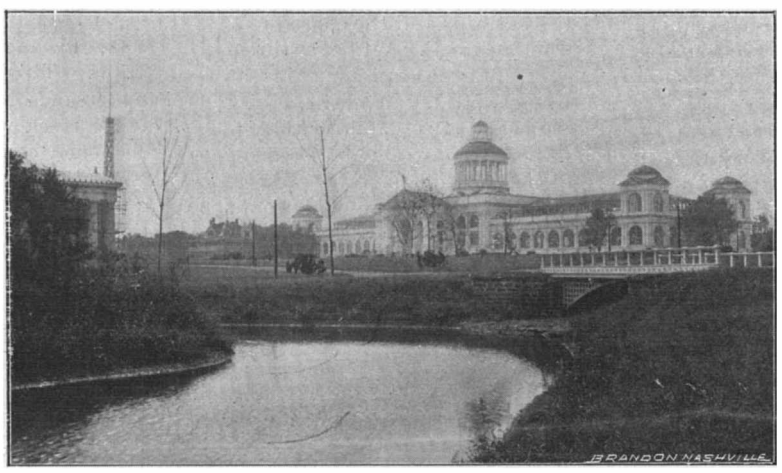
The selection of a site for the Exposition was a happy one. The old West Side Park and contiguous property was secured, the area covered being 200 acres. The tract is a magnificent stretch of blue grass land lying within two miles of the public square of Nashville. The ground was improved at once. Two beautiful lakes were created, the rolling surface was terraced, 1,000 trees were planted and miles of drives, walks and bypaths were laid out, while the drainage and lighting has been carried out on approved lines. By May 1 the Park will be all that a perfect climate, a fertile soil and artistic landscape gardening can make it. In the great circle around the center lake is an imposing collection of monumental, though ephemeral, Exposition buildings. As will be seen by reference to our bird's eye view, the ensemble is most imposing; in fact, it looks like a bit of the Columbian Exposition, set down under kinder skies, in a more genial climate. In front of the magnificent reproduction of the Parthenon, which is the centerpiece of the Exposition, stands a heroic statue of Pallas Athene, 43 feet high. A little further on is a reproduction of the famous bridge of Venice, the Rialto.



PARTHENON FROM COLONNADE.

The Parthenon, the noblest example of ancient architecture, is reproduced exactly, as to outward form and color, and stands on a considerable elevation. It is a fireproof structure and is intended to house the art collections. The light comes from a large skylight in the roof, as in all Greek temples. The largest building on the grounds is the Commerce building, which is at the left of the Parthenon. Its dimensions are 500 × 315 feet, the wings being 150 feet wide. The height of its central dome is 175 feet. This building will house many of the important exhibits, both foreign and domestic. Tennessee is a great agricultural State, producing almost every crop grown in two zones. Naturally their agricultural exhibit was given one of the finest buildings on the grounds. It measures 525 × 175 feet. As is the case with the other buildings, the exterior is covered with staff. The building to the right of the Agricultural building is the Machinery building, constructed in the Doric style. It is of the type of the famous Propylæum in Munich, and measures 375 × 138 feet. In order that the building may be pleasant on warm days, no steam will be admitted, but the boilers and engines will be at the power house, which is directly back of the Agricultural building. Simplicity is the feature of the design selected for the Transportation building, which is directly opposite the Machinery building, across the little lake. A most pleasant effect has been obtained, without the use of a single column, merely in the grouping of the masses in the proper proportion.

The building has a frontage of 400 feet and a depth of 125 feet. Next to the Transportation building is the History building, where the historical relics of the State will be exhibited. The design provides for a Greek cross with a dome. One wing will be used for colonial history, another for early times in Tennessee, the third for Confederate relics, and the fourth for Federal relics of the late war. The building will, of course, be made fireproof, owing to the great value of its contents. The space between the two lakes back of the Parthenon is devoted to the minerals and forestry, the Auditorium, the Horticulture and the Government buildings. The Minerals and Forestry building is built in the Roman-Doric style. It measures 400 feet by 125 feet. The building will prove especially attractive to those who are interested in the wonderful mineral and timber resources of the Middle and Southern States. In the southern end beautiful marble, onyx, granite and sandstone specimens will be shown, while at the northern end will be placed all grades and kinds of coal and countless varieties of timber. The Auditorium is colonial in design and Ionic in treatment. The interior of the building is furnished in hard wood, the seating capacity being 6,000, and the stage and band pit are ample for all purposes. Above the colonnades are pleasant balconies for the viewing of pageants by day and the elaborate electrical and fireworks displays by night. The tower is 140 feet in height and affords a magnificent view of the exposition. The Women's building occupies the corner of the Exposition grounds, and is designed by a woman, as the building is devoted entirely to women and their work. An assemby hall is provided for meetings under the control of the women's board. Other rooms are devoted to the various arts and industries in which women have been engaged; one section being devoted to patents taken out by women, another to books and musical compositions by women, and so on, to painting, sculpture, cooking, embroidery, education, etc.



COMMERCE BUILDING FROM LAKE.

The Children's building is one of the unique features of the Exposition. It belongs to the children, and in it various things will be designed and arranged for their amusement and instruction. The design of the building is pretty, and fills the interval between the Administration and the Women's buildings. The most interesting department will be that in which the work of the children will be exhibited. Another section will present whatever is of interest and use to the children gathered from all over the world. In the rear of the building, for the pleasure of the little visitors, a park of tame deer will be kept.

The offices of the Exposition will be located in the Administration building, a handsome structure, erected in the club house style, with hard wood interior and wide porches. The offices are furnished with every convenience.

The United States Government building is directly back of the Auditorium. It is destined to contain an interesting exhibit of the various departments of the federal government.

Among the other

AUDITORIUM.

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buildings are the History building, the Negro building, Dairy, etc.

Excellent means of transit to and around the grounds have been provided.

The amusement feature of all world's fairs has come to be regarded as a very important one, and in America this section is now universally known as the "Midway," in honor of the Midway Plaisance of the Chicago Exposition, but in the Tennessee Exposition a new name has been devised for this interesting center. It is called "Vanity Fair," after the show mentioned in "Pilgrim's Progress," which was seen by Christian in his journey through life. In the triangle of the ground many features which were attractive at the World's Fair will be in evidence, as well as a number of new shows. The Director General has, however, decided that there shall be no exhibitions which will be offensive to any one. Another of the special features which add to the beauty of the grounds will be what is known as a "gourd arbor." This will be a long avenue leading from the main entrance of the Auditorium to the walks of the western part of the park. A light, airy framework covers the walk, which will be overgrown with flowers and vines.

It is, of course, too early as yet to give any idea of what the exhibits will be, but there is every reason to believe that they will be so interesting that visitors will come from every State in the Union, and possibly from abroad. The foreign commissioner of the Exposition spent a long time in Europe, and obtained a large number of commercial exhibits from abroad. The chief officers of the Exposition are: Mr. John W. Thomas, president; Messrs. V. L. Kirkman, W. A. Henderson and John Overton, vice presidents; and Mr. Charles E. Currey, secretary. The Director General is Mr. E. C. Lewis. The buildings are under the direction of Mr. Robert T. Creighton, engineer, and the chief of the Bureau of Promotion and Publicity is Mr. Herman Justi, to whom we are indebted for courtesies.

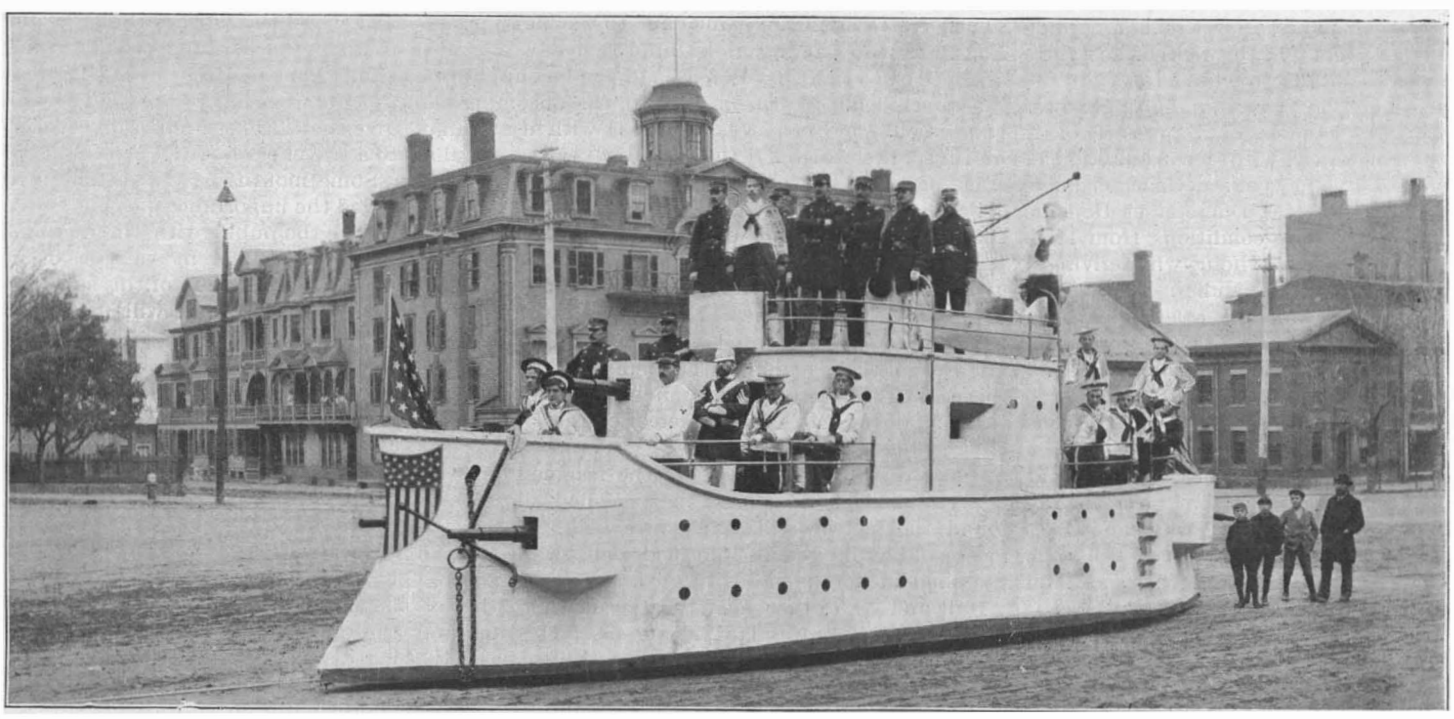
PARTHENON AND AUDITORIUM.

French Waterways.

According to an official report recently issued there were in France, at the close of 1895, says the Engineering and Mining Journal, a total of 13,751 kilometers of interior navigable waterways, of which 8,838 kilometers were rivers, lakes, and other natural channels, and 4,913 kilometers were canals. The natural waterways include a number of rivers which have been made navigable for at least part of their length by dams, locks, or other artificial works. From 1878 to 1895 there was an increase of about 15 per cent in the total length reported, chiefly due to the improvement of rivers. These channels are under the control of the State, and are divided by law into two classes. Waterways of the first class must be able to carry boats of 2 meters draught, and the locks, if there are any, must be able to pass boats 38·50 meters long and 5·20 meters beam. There are 4,204 kilometers which come up to these requirements; all the rest are of the second class. The total quantity of freight moved on the rivers and canals in 1895 was 27,173,904 tons. Of this traffic 32·3 per cent was stone, brick, lumber, and building materials, 28·1 per cent was coal, and 7·4 per cent was iron, steel, and other metallurgical products. These three items make up 67·4 per cent of the total. The waterways were used, as might be expected, chiefly for the carriage of heavy freight, which must be moved at a low cost.

A TROLLEY MAN OF WAR.

While the comic papers have been cartooning military engagements of the future as between portable forts operating on trolley lines, it has remained for the enterprising superintendent, W. W. Sargent, of the Fitchburg & Leominster, Mass., Street Railway to actually build what to all appearances was a very formidable fighter. Like the steam locomotive copy built at Terre Haute, this new idea is suggestive of endless possibilities for future occasions of celebrations, parades, and novel special cars. The cruiser McKinley was operated through the principal streets of Fitchburg and surrounding towns during the late presidential campaign, and was in every way a success, serving as a novel feature in many parades and making all its trips without a breakdown or accident of any kind. At one time it carried one hundred and four men, this being the entire crew of officers and men. The car was designed to run slowly through the street during a procession with its crew marching in front, on both sides and in the rear, while many of the officers would ride, then during a long jump from town to town, officers and men would ride together. The boat, which is 37 feet long, was built on a construction car 26 feet long with 6 foot 6 inch wheel base, equipped with two 12-A, 30 horse power Westinghouse motors. It was constructed of sheathing and timber, the whole being covered with canvas painted and varnished. The hull was painted white, superstructure cream, ironwork bronze, guns, and anchor chain black, sponsons, lifeboats and turrets white. It was lighted with twenty-five incandescent lamps. Red fire was used on many occasions in the smokestack which gave it a decided martial appearance. After celebrating the victory, special parties were given an opportunity to enjoy the novelty of a ride on the cruiser. A few days ago she was dismantled and will be erected on a raft at the pleasure park of the company (Fitchburg & Leominster Street Railway) in early spring. The boat was designed by naval architect W. W. Lapointe, and was constructed at the car house of the Fitchburg & Leominster Street Railway Company, under the direct supervision of its superintendent, W. W. Sargent. We are indebted for the foregoing particulars and for our engraving to the courtesy of the Street Railway Review.



TROLLEY MAN OF WAR USED IN THE LATE CAMPAIGN.

Coal Consumption on a Cruiser.

The results of the thirty hours' coal consumption trial of the second-class cruiser Juno recently were as follows: Steam in boilers, 142 pounds per square inch; vacuum, port 27·1, starboard 26·1; revolutions, port 117·9, starboard 119; indicated horse power, 4,863; giving a mean speed of 16·3 knots per hour. The amount of coal used was 1 64 pounds per indicated horse power per hour. The Juno was taken into the Channel for a four hours' forced draught trial. The mean results recorded were: Steam in boilers, 149 pounds; in engines, 151 pounds; vacuum, starboard 26 inches, port 26·6 inches; revolutions, starboard 149·3, port 149·3; indicated horse power, starboard 4,832, port 4,939—total, 9,771; air pressure, 0·92 inch; speed, 20 knots, or half a knot in excess of contract. The vessel returned to Devonport Harbor, where she will be equipped for sea.

THE Rockefeller steamer Robert Fulton, 440 feet over all, is the largest steamer on the Great Lakes.

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Notes on Acetylene.

The following notes on acetylene are extracted from recent technical journals :

A firm of Italian engineers has recently constructed some small cars which are propelled by motors driven by acetylene gas. The charge consists of acetylene gas dissolved in fifteen times its volume of air, and with this mixture it has been found unnecessary to use water for cooling the cylinders. The method of igniting the charge has not, however, been made known. According to the Gaztechniker, the motors maintain a speed of 600 revolutions throughout a working period of fifteen hours. The weight is only about 20 lb. ; and 0·8 brake horse power is developed. The cost of working is said to be about 12 cents per hour.

At the ordinary monthly meeting of the Newcastle-on-Tyne and Northern Counties Photographic Association, Mr. John Watson read a paper on the use of acetylene for photographic purposes, which was admirably illustrated by a demonstration of the use of acetylene in the lantern. There was a good attendance of members and friends. In his very practical and interesting remarks, the lecturer considered this light very suitable for professional men, who, using a portrait lens, got a fully exposed plate at any time, no matter what the atmospheric conditions might be, with an exposure of about four seconds. He contended that in the very near future acetylene gas will be largely used for the purpose of lantern illumination. The light, which at the present time is largely used, is intensely white, in burning it has no smell, is absolutely safe, and, if not as good as the limelight, is very nearly so, and when once lit up it requires no attention.

Some actual trials have been made on the Swiss railway between Berne and Zurich of lighting by acetylene, with the following result: A kilogramme (2·2 lb.) of calcium carbide produces about 250 liters (9 cubic feet) of acetylene gas, the consumption of which is 0·7 liter (42 cubic inches) per candle power per hour, for flames varying between 20 and 30 candle power, being slightly greater for smaller lights. At the present price of $10 per 10 kilogrammes of calcium carbide, a cubic meter (35 cubic feet) of acetylene costs 40 cents, giving the same light as five times the volume of compressed oil gas.

An acetylene gas motor, weighing 9 kilogrammes (20 pounds), giving out a brake power of 62 kilogrammes (448 foot pounds), and capable of working fifteen hours without being touched, has, it is stated by the Rivista Tecnica Italiana, been designed by Sig. Pedrell, of Parma, who has fitted it to a bicycle.

The method by which M. Raoul Pictet purifies acetylene is given in a recent issue of the Gas World. It is based upon the failure of certain chemical reactions when the material is exposed to low temperatures. At —50° C. (— 58° F.) sulphuric acid does not act upon acetylene, but it does act upon the impurities usually found in that gas when made from calcium carbide ; and therefore the gas, as it is formed from the carbide, is passed through that acid, which retains the impurities. The purified acetylene is then more manageable and more easily liquefied, while its obnoxious odor, its liability to spontaneous ignition (through the presence of phosphureted hydrogen), and its action upon metals are very largely got rid of, while the light produced is intensely white and bright.

One kilogramme (2·2 pounds) of calcium carbide should yield about 300 liters (10 cubic feet) of acetylene gas. A good burner, says l'Electro-chimie, specially designed for this gas, should give an illuminating power of nearly fifty standard candles, at a pressure of 40 millimeters ($1\frac{19}{32}$ inch of water), with a consumption of 30 to 35 liters (about 1 cubic foot) of acetylene per hour; and some burners made by MM. Ducretet et Dejeune only consume, under the same conditions, from 11 to 12 liters (mean 0·38 cubic foot) per hour, while giving a light of nearly twenty standard candles. Acetic acid retards the action of water on the calcium carbide, this effect being all the more marked in proportion to the quantity of acetic acid contained in the solution.

The specific gravity of acetylene, as compared with air, is 0·91, and one liter = 1·6 pints of liquid acetylene at a temperature of 32° F., weighs 450 grains = 157½ ounces, and is evaporated into 375 times its volume at the ordinary pressure, 760 millimeters = 29 inches. Like carbonic acid, when liquefied, acetylene passes into the state of snow if allowed to escape from the receiver in which it is liquefied ; and this snow, on evaporating, lowers the temperature 182° F. At the temperature of 68° F., the pressure in the receivers containing liquefied acetylene is 42·8 atmospheres = 628 pounds per square inch ; and it becomes 68 atmospheres = 1,000 pounds per square inch at 986° F. These pressures are higher if the liquid, at these temperatures, fills the receiver. On account of these high pressures, and as this gas is endothermic, the cylinder containing liquid acetylene must be handled with great care, and the escape of acetylene at the closing cock of the receiver, or at the reducer of pressure, is difficult to avoid. For these reasons the use of liquid acetylene, says l'Electro-chimie, should be placed under strict control.

The Commercial Navies of the World.

The latest edition of the "Repertoire General de la Marine Marchande," published by the Bureau Veritas, contains the usual general summary of the steamships belonging to the different maritime nations, and measuring 100 tons gross and upward, as also the accustomed list of sailing vessels measuring 50 tons net and upward, and likewise a list of the smaller vessels which are classed in the Veritas Register. The following table shows the number of steamers of over 100 tons, and the collective gross tonnage belonging to the sixteen principal maritime nations—that is, whose aggregate gross steam tonnage surpasses 100,000 tons.

	Steamers, 1896.	Gross tons. 1896.
Great Britain and colonies	5,690	10,245,577
Germany	831	1,360,472
France	532	933,244
United States	477	761,707
Spain	365	519,315
Norway	551	494,612
Italy	222	344,523
Holland	204	320,794
Japan	267	313,563
Russia	314	277,302
Austria-Hungary	156	254,269
Denmark	265	248,773
Sweden	427	233,777
Greece	107	144,975
Brazil	314	139,305
Belgium	66	139,300

Besides the steam tonnage set forth in the above table, there are 2,667 small steamers (below 100 tons), measuring altogether 415,069 tons gross. The number of existing steamers whose measurement is between 5,000 and 6,000 tons is 131; between 6,000 and 8,000 tons, 59; those over 8,000 tons, 25, and of these eight are of more than 10,000 tonnage, viz., the Campania, Friedrich der Grosse, Georgic, Lucania, New York, Paris, St. Louis and St. Paul. The general total of the steamers of over 100 tons is given in the Repertoire as 11,155, representing 17,089,596 tons gross and 10,761,025 tons net. The sailing tonnage is divided among the principal maritime nations as follows—thirteen nations possessing sailing tonnage of over 100,000 tons.

	Ships. 1896.	Net tons. 1896.
Great Britain and colonies	8,726	3,267,625
United States	3,881	1,358,467
Norway	2,801	1,176,174
Germany	1,096	566,973
Italy	1,692	472,002
Russia	1,753	363,046
Sweden	1,444	285,665
France	1,425	252,940
Greece	1,059	246,196
Turkey	1,247	241,096
Spain	1,115	167,143
Denmark	795	149,843
Holland	642	139,649

The Meteor Fell at His Feet.

The remarkable experience of witnessing a meteor flashing across the firmament, watching it in its course and seeing the stone drop to earth within a few yards of where one is standing comes to but few people, yet such a happening occurred recently to a citizen of Albina, Oregon, says the Portland Telegraph. It was shortly after 10:30 p. m. that Mr. Hall started to go to his lodgings. Reaching the corner of Rodney Avenue, he was startled by a sudden illumination of the sky toward the east. Gazing aloft, he saw what at first he took to be a ball from a Roman candle fired from some pyrotechnic display incident to the many processions. As the flaming globe approached, however, it assumed such size that the Roman candle supposition was precluded. Nearing the earth, the oncoming ball of fire could be seen to be bringing with it a trail of bluish sparks, which left the main body with a peculiar cracking sound resembling the snapping of charcoal.

Barely missing the roof of a house, the visitant from the heavens took a long, swooping flight, as though repelled by the earth's surface, finally alighting in a bed of hardpan, burying itself to a depth of some five inches. The distance from where Mr. Hall was standing to where the meteor alighted was so slight that he had a fair view of that portion of the meteor exposed. From this came a shower of sparks, much the same as though the component parts of the meteoric visitor contained a percentage of saltpeter.

Going over to the spot where the fragment of some heavenly body broken loose in space had alighted, he found the meteor still at a white heat. Having no means of handling it, he informed some people there of the phenomenon he had witnessed.

Hall and two other men then returned to the lot. On the way an empty lard kettle was picked up, and reaching the spot an attempt was made to scoop the fragment of a disintegrated planet into this plebeian receptacle. The piece of the meteor, on being moved, emitted fumes so pungent and nauseous as to drive the meteor hunters away. After waiting some minutes for the stone to cool, the party again tried to get it into the kettle, but were again driven back by the odor of the gases. A third attempt was, however, successful, and the meteor was borne back to Turner's.

The piece is of an irregular shape, much resembling a lump of hard clay that had broken loose from a cut and rolled to the roadbed below.

Science Notes.

Dr. Nansen has ordered a yacht of about twenty tons burden and intends to continue his studies on the coast of Norway and Spitzbergen with it.

Mr. William Crookes, F.R.S., who has been experimenting with the alleged new element "lucium" has arrived at the conclusion that it is not an elemental substance at all, but simply impure yttrium.

A recently discovered mountain lake on the island of Fernando Po is situated at an altitude of 1,330 meters and is 1,170 meters long and 800 meters wide. High mountains surround the lake and a waterfall leaps into it, but there is no visible outlet.—Prometheus.

A new lamp shade invented by A. Von Kozlowski, says the Gewerbe Zeitung, Vienna, is made hollow, to be filled with a suitable liquid, such as a very dilute solution of sulphate of copper with a slight addition of ammonia. This shade absorbs the heat and reflects the light, at the same time giving it an agreeable color.

According to the Comptes Rendus, there has been considerable interest in scientific balloon exploration recently in France. A number of captive balloons were sent up from different stations in the night between November 13 and 14, and at the same time free balloons ascended from other stations. The free balloon sent off from Paris rose to the height of 15,000 meters, and recorded a temperature of —60° C.

When the Cornell scientific party was in Greenland last summer an extensive collection of botanical specimens was made, but as nearly all the species were new to the collectors, it was not known how valuable the collection was. As it turns out, practically all are rare and valuable. As there are many duplicates, the National Museum at Washington and the museums of various universities will be enriched as well as that at Cornell. There are in the collection specimens of full grown forest trees less than three inches in height.

Prof. Wm. P. Blake, Director of the Arizona School of Mines, reports, says the Engineering and Mining Journal, the occurrence of wolframite, or tungstate of iron, at several localities in the southern part of Pima County, Ariz., specially in the Arivica mining district, where it is associated with gold-bearing quartz. This occurrence of an ore of tungsten in auriferous quartz veins is rare and unusual, but has been before noted by Prof. Blake at Murray, Idaho, where there is a vein of tungstate of lime, or the species scheelite, alongside of a gold-bearing quartz vein.

The coldest region on earth is the country around Werchojansk, in Siberia, says Prometheus, where the thermometer sometimes falls below 68° Centigrade below zero (90° Fahrenheit below zero). The average temperature of January is 49° Fahrenheit below zero. Notwithstanding this rough climate, more than 10,000 people inhabit that region. As the air is generally calm and dry in winter, the cold is not felt very much. The variations of the temperature within twenty-four hours are very great in summer ; in May, for instance, the thermometer will sometimes rise to 85° Fahrenheit during the day and fall to freezing point at night.

An apparatus for testing the durability of bicycle wheels described in Uhland's Wochenschrift consists of a frame receiving the bicycle wheel and weights corresponding to the average weight of a rider. The wheel to be tested rests with its tire on a large pulley rotated by machinery, and the pulley has on its rim a series of projections of various width and height. The wheel thus strikes the projections and is subjected to the same strain as when striking obstacles on the road. The test is continued for about twelve hours, the pulley being rotated at such a rate of speed as to give the wheel a number of revolutions corresponding to a travel of about 170 miles.

Some months ago an article in the Home Journal urged the importance of some systematic effort to familiarize the public with the distinguishing characteristics of the different varieties of mushrooms. Now a society for the study of this subject has been organized in Philadelphia. It will meet every two weeks, and members will read papers on such topics as "Mushrooms That Have Helped Me." The organizers say that there are about two hundred and thirty-five edible kinds of mushrooms to be found around Philadelphia, and that tons of the delicious food go to waste, simply because people have a horror of what are known as toadstools, though the really poisonous varieties are few.

Cazal and Catrin (Annales de l'Institut Pasteur, ix, 12 ; Centralblatt für innere Medicin, December 12, 1896) have investigated from the bacteriological standpoint the question of how far books are capable of conveying disease. A book from a hospital circulating library was found to contain a number of saprophytes, and in addition a few pathogenic germs, staphylococci and the Bacillus subtilis. Even a new book, fresh from the publisher, was not sterile, but showed only harmless bacteria. The authors infected several books with known pathogenic species, and a few days later implanted bits of the leaves in culture media. The streptococcus, the pneumococcus, and the diphtheria bacillus were thus found to be communicable by books, but the typhoid organism and the tubercle bacillus gave negative results.

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Progress in American Tea Culture.

BY GEORGE ETHELBERT WALSH.

The prospects of making tea an American product would be poor indeed if it were not for the energy and perseverance of Dr. Charles U. Shepard, who has spent a good part of his life in experimenting with tea plants on his Pinehurst farm in South Carolina, and whose annual crop of leaves creates a little sensation in that branch of the commercial world which deals in imported teas. The success of the Pinehurst tea gardens is made more important in view of the floods of cheap, inferior teas that have been imported into this country to the detriment of the trade since the tariff was reduced; for the sole aim of the owner of the Pinehurst farm is to produce a quality of tea that will command the highest prices in the market. In his own words, "Asiatic cheap labor, at six to eleven cents daily wages, precludes competition in the inferior sorts."

In 1892 the first crop of tea ever raised in this country was cured and sold in our own markets, but the total product did not exceed 150 pounds, as only the small and tender leaves were picked. Since then the crop has steadily increased, and the prices realized for the Pinehurst tea have exceeded $5 per pound. The yield of the tea plants has proved as high as that of the best Indian gardens of the same age, and the rate of production at Pinehurst has averaged 250 to 500 pounds from every garden of 1,500 plants. This rate could be greatly increased if the large leaves were picked, but the small, young leaves are the only ones suitable for the manufacture of the high grade teas.

The original tea plants of the Pinehurst farm were planted in the old gardens near Summerville, South Carolina, before the war, and they were neglected for nearly twenty years thereafter, growing wild in clumps and thickets in spite of their uncongenial surroundings. Dr. Shepard obtained possession of the gardens, and while some of the plants were transferred to better situations and soil, many were left standing in their original locations. From these early planted shrubs the present Pinehurst crop was raised. At the same time the owner obtained consignments of seed from our consuls in China. These have obtained a good age now, and the plants are vigorous growers. A great part of the deterioration of the tea plant in China has been the result of neglect, and consequently the shrubs from similar seeds planted at Pinehurst have produced finer foliage than those in China. This improvement in the Chinese tea plants through careful cultivation has been one of the most encouraging features of the work at the South Carolina garden.

But most of the crop heretofore gathered in this country has been of the Assam hybrid plants. The true Assam tree is a vigorous grower, with leaves seven or eight inches long and three inches broad, capable of producing twenty-five crops of young leaves in a season, but cold interferes with the proper development of this variety, and it cannot be profitably grown outside of a small part of British India. In its natural, unpruned state the plants frequently attain a height of thirty or more feet. Intermediate between this large tea plant and the small Chinese variety, there are many kinds that have resulted from hybridization. These hybrids represent good and bad teas, with all the possible modifications between the two extremes. In gardens where hybrid seeds are planted indiscriminately, both the broad and narrow leaves are found, and also inferior and extra fine tea leaves.

In experimenting with tea growing in this country, the question of varieties early occupied the attention of Dr. Shepard, and it required considerable study and comparison of data to ascertain just what results might be expected from the leading plants of China and Ceylon. A comparison of the records of the climate of Charleston, a short distance from Pinehurst, and those of other tea-growing countries over a period of ten years, showed that it was not an impossible thing to raise tea in parts of South Carolina. The mean yearly climate was about the same as that of the upper stations of Ceylon, but much warmer than in Japan. The winter season in Upper Ceylon, however, rarely brought ice, while at Pinehurst its appearance is nothing unusual. In Japan frost and ice are common. The rainfall in Ceylon is much greater than in either Pinehurst or Japan. From these observations, it is apparent that South Carolina has too little rainfall and too great extremes of climate to produce the finest tender varieties of Ceylon tea. Artificial irrigation partly supplies the first deficiency, and the protection of the tea gardens by windbreaks made of trees helps to offset the second disadvantage.

The tea fields of Japan, which more closely resemble those of South Carolina than any other, send us annually 50,000,000 pounds of tea. The Ceylon and India tea growths are not so popular in this country, as the leaves are strong, and delicate and light infusions are preferred here. Carefully selected Indian and Ceylon seeds are expensive when brought to this country, but when they once become established they are vigorous growers. The cost of eighty pounds of the seeds delivered in this country averages about $50, but as only about one-fourth of them are good for anything when they arrive here, the cost is much greater than appears at first. Many of the seeds sent here do not represent the varieties that are claimed for them, and this is another source of worry and disappointment. Of the many pounds of seed imported for the Pinehurst farm, only very few have yielded satisfactory results, and now more reliance is placed upon the cuttings for propagation than upon the imported seeds. The gardens are so well established that there is ample stock on hand for increasing the number of plants from cuttings.

During the few severe winters we have had, the tea plants at the Pinehurst farm have suffered more or less, but the number actually killed is not great enough to discourage any one embarking upon the enterprise. The winter of 1892–93 was severe enough to kill a few of the tea plants, and to impair the vigor of others. The winter of 1894–95 was another severe test of the plants.

The experiences so far seem to point to the conclusion that tea plants can be raised at a profit in South Carolina either from seed or from cuttings, and that the Chinese and Japanese sorts are better adapted to the climate than the India or Ceylon teas, although many of the Assam hybrids develop into tolerably luxuriant plants. The crop must of necessity be of a high order, and to accomplish this only the young leaves can be picked. The question of profit, however, is not settled when good plants and leaves have been produced. The cost of picking and curing the leaves is much higher than in China, Japan, India or Ceylon, and herein lies the real difference between the industry in this country and the Oriental lands. A high tariff on tea would prevent the importation of many of the inferior grades now brought into this country, and incidentally it might help tea growing in the South. But better than this would be the invention of machinery for reducing the cost of picking and curing. The substitution of machinery for manual labor would immediately bring into existence a considerable industry in tea raising.

The industry at present is not attractive to the average farmer, for a tea garden of only a few hundred acres would involve the expenditure of considerable money, with no prospects of getting any profits back inside of five or six years. If a central curing factory could be established in the best tea growing districts, it might be possible to induce farmers to cultivate ten or twenty acres of tea plants as an investment for the future. Even with the present prices paid for labor in the South, the best quality of teas can be raised at a good profit, or at least, this has been the case for several years on the Pinehurst farm. The picking is the most expensive work, but, while long and tedious, it is not arduous labor, and women and children can do it equally as satisfactory as men.

The Formation of Natural Bridges.*

Prominent among the rock formations which have attracted the attention of student and sightseer alike are the arches of solid stone spanning deep chasms and forming an unbroken union between massive cliffs on either side. Were they more common, they would be, perhaps, less noted; but so far, very few of them have been brought to public notice, and it is probable they are of rare occurrence. The opinion has been advanced by some geologists that natural bridges are the remains of former caverns. It frequently happens that the roof of an underground chamber approaches so near to the surface of the earth as to be unable to support the weight of rock and soil above it; consequently it gives way, forming a sink hole. If this process continues a sufficient length of time, the entire roof will fall in and the cavern become an open ravine. Sometimes, however, one portion of the roof may be so thick or so strong as to hold its position after all that part to either side of it has disappeared; and this fragment which remains constitutes what is known by the name of a "natural bridge." While this theory is simple and may be correct in regard to some of these formations, it is clearly erroneous when applied to others. Caverns are usually very tortuous, seldom preserving the same direction or level for any considerable distance, and there are very few whose shape is such that they could under any circumstances be converted into open ravines. Still, such do exist; and the above theory is satisfactory concerning bridges found under such conditions. But there are at least three other varieties of these formations for which it cannot account; and for each of them a separate explanation is necessary.

As a type of the first class may be taken the most famous and perhaps the largest natural bridge in the world; namely, that in the Shenandoah Valley of Virginia which gives its name—Rockbridge—to the county in which it is found. In this instance, the strata terminate at the river hills on one side, and rise to the surface of the ground beyond the bridge on the other. Water sinking into the earth sought an outlet toward the James River by following the lines of separation between the strata; and dissolving the limestone through which it flowed, produced a tunnel or underground passage open at both ends. The upper strata were much less affected by this erosion than the lower; for a smaller amount of water made its way into them, besides which they were, from their position, compressed and hardened and thus better enabled to resist the destructive process. When this passage became well defined the wear was almost entirely at the bottom and ends; the central portion suffering no further change except that resulting from atmospheric agencies. No cave has ever been discovered whose ramifications bear the slightest resemblance to those produced by surface drainage, nor one in which the various branches from a central chamber lead, without exception, to the surface of the ground at different points. In Hardy County, West Virginia, a considerable stream, known as Lost River, completely disappears within a few rods, the water sinking between the strata of a syncline and reappearing on the other side of the mountain in a number of great springs whose united waters form the Cacapon River. The rock is a hard, compact shale or slate; if it were limestone or other mineral soluble in water, there would be at this point a tunnel two miles long. Probably in this manner was formed the tunnel in Scott County, Virginia, through which a public road once ran, and which is now utilized by a railway company.

The tunnel and natural bridges of Carter County, Kentucky, which may serve as a type of the second class, had their beginning and development in a somewhat different manner, by reason of the difference in the geological conditions. Here the surface rock is a very hard carboniferous limestone, passing by a continually increasing admixture of quartz sand into a typical sandstone below. As soon as a depth is reached at which the sand becomes appreciable in amount, false or cross bedding is very marked. Water passing through the upper layers dissolved more or less of the lime which acts as a cement for this sandy material, and when an outlet was once made below, the disintegration proceeded rapidly, until the nearly pure sand rock at the bottom was reached. In this way have been created two bridges, each surpassing in some respects that of Virginia, and a tunnel several hundred yards in length. Riffles and shallows, alternating with deep pools, are common in the streams of this region; but there are no underlying strata, at least none at present within reach, through which other streams may burrow. Four large caves in the vicinity have been thoroughly explored; and there is no point in any one of them where it would be possible for a bridge to form having any resemblance to those existing. The only similarity in the formation of the two phenomena is that both are results of underground drainage; and in none of them could the causes that have produced the one class have given rise to the other.

The third class which remains to be explained may be found in the massive, bedded limestone of the devonian and subcarboniferous deposits, better known in various localities as the "mountain," "cliff," or "cavern" limestone. Such stone, being formed under the ocean, must contain a large amount of water; when it is elevated above the sea level, this water drains away, and the stone must shrink, just as green wood does when it is seasoned. In this way are formed seams, or "joints" as they are called, which extend for a considerable distance downward, sometimes almost vertical. Surface water finding its way into these gradually enlarges them, forming sink holes or "natural wells." Under ordinary circumstances, this water will continue to make its way downward, forming a cave, or it will reappear at different places in the shape of springs. If, however, there should be a stream or a deep ravine in the immediate vicinity, the water may reach this by following the lines of separation in or between the strata; and by constantly enlarging the passage thus made, it may form in time a ravine whose sides are united by the higher beds of the rocks through which it has bored its way. The famous "arched rock" at Mackinac Island may be taken as a type of bridges formed in this manner. Near the Kentucky caves above mentioned is a natural bridge formed somewhat in the manner as those last described; but the rock in which it occurs is a sandstone instead of a limestone. Several yards back from the brink of a precipice is a vertical crevice in ground which is dry except immediately after a rainfall. Storm water, flowing into this and reaching the surface again near the foot of the bluff, has eroded the stone until it now presents an arch resembling that of Mackinac, but much larger in all its dimensions.

* Popular Science News.

Counting Blood Corpuscles.

Dr. Judson Daland, of Philadelphia, has invented an instrument for counting blood corpuscles, according to the Physician and Surgeon. It works on the centrifugal force principle, and accomplishes the measurement by means of comparative bulks. A quantity of blood is placed in a finely graduated tube and the latter revolved at a speed of about 1,000 revolutions a minute. The corpuscles divide by force of gravity, and form on the side of the tube in easily traceable divisions of red corpuscles, white corpuscles, and serum. The new method permits of larger, and consequently more representative quantitatives being used in experimenting, besides doing away with actual microscopic counting.—New York Medical Times.

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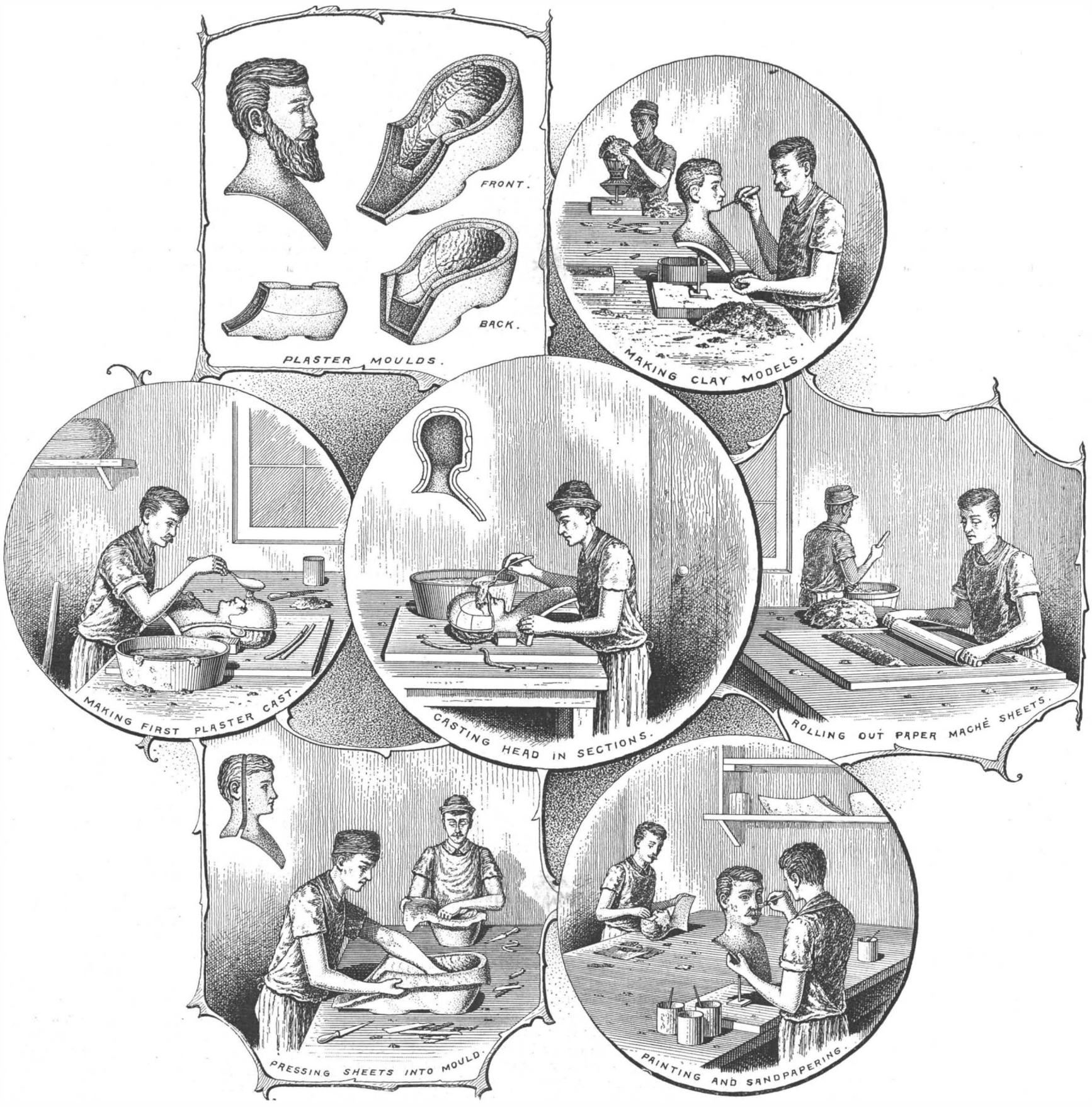
MANUFACTURE OF PAPIER MACHE BUSTS.

The illustrations accompanying this subject represent the manufacture of papier maché busts used principally by clothiers, milliners, etc., for show purposes. The busts are generally fastened over the top of wire frames made the same shape and size of a man or child, over which suits of clothing are placed to show the quality and style of the material. The material used for these busts is composed of a mixture of carpet paper, or felt, whiting, glue, linseed oil, and shellac, the material being stirred and mixed together with water to about the consistency of dough, and then rolled into sheets and pressed into plaster of Paris moulds. The first operation in the manufacture of these busts is the making of a clay model. A frame is first formed of pieces of wood made about the same size and shape of a head and bust. The frame is supported in an upright position by means of a circular iron rod running up through the center, it being fastened securely to the top piece of the frame by means of iron nuts. The model maker then plasters the clay roughly over the framework to the depth of about an inch, and then with his tools forms out the features. The tools are made of steel and are curved and slightly spoon shaped at the ends. It requires about one week to form a life size model, about twenty pounds of clay being used for the operation. After drying for one day, it is then ready to have a cast taken from it. The cast is made of plaster of Paris in two sections, the front, or face, being formed first. A strip of clay about one inch in thickness is first placed all around the clay head, as a dividing line between the front and the back section. The plaster of Paris is then poured all over the section by means of a large spoon, to the thickness of an inch, and left to set for about five or ten minutes. After setting, the clay strip is taken off, the model turned over, the plaster of Paris joint of the front cast oiled, and the back then plastered over in the same manner as before. After the back section has set, the two parts are then removed from the clay model. Another cast is then made of the interior of the plaster cast, which forms a duplicate cast of the original clay model. The plaster duplicate, when set, is then taken out of the jacket and scraped and smoothed into a perfect working model. A cast of this model is then made in small sections, a strip as before being placed on the model, spacing off the section to be cast.

After the small section has been cast and set, the clay strip is removed and placed again in position for the adjoining section. This operation is continued in the same manner until the entire head is cast. Some of these heads are composed of about twenty-five pieces, it requiring about two days to perform the operation. When the casting is completed over each half a plaster of Paris mantle or jacket is then cast over the sections, from about three-fourths to one inch in thickness, the operation taking about 1½ hours. The plaster jacket is allowed to set for about ten minutes. The sections or parts are then taken out of the jacket and dried thoroughly for about twenty-four hours and then shellacked. They are then put in place again as before and are ready for the papier maché. The ingredients forming the papier maché are mixed with cold water into a pulpy mass like dough. A quantity of the material when ready is placed on a marble slab about three feet in length and two feet in width, and rolled out in sheets ranging from 12 × 15 inches in width to about 15×22 inches in length and about from three-sixteenths to one-fourth of an inch in thickness. The operator, when the sheet is rolled out, places it while wet into the mould. The material is then pressed into the form by hand, the operation taking about one-half hour. After the papier maché is pressed into place, the overlapping edges are trimmed off with a knife and the moulds laid away on shelves to dry for about fifteen hours. After drying, the two mould sections are put together and the two papier maché joints fastened together by pressing a little of the wet material along the joints on the interior, after which the mould is left to dry again for twenty-four hours. When the joints are thoroughly dry the papier maché head is taken out and sandpapered and painted. The head is smoothed off by rubbing over the surface No. 2 and No. 3 sandpaper, after which the head is given a coat of bluish white oil paint and then two coats of flesh color. The eyes, hair, lips, etc., are painted with tube colors. The sketches were taken from the plant of H. A. Buchholz, New York City.



MANUFACTURE OF PAPIER MACHÉ BUSTS.

THE supreme court of Italy has recently decided that the original manufacturers of phenacetin are entitled to the exclusive use of the name "phenacetin," although said name is now in common use. The ground given is that phenacetin, although not a purely fanciful designation, is not the proper and official chemical name of the substance, and that the original manufacturers were the first to adopt the name phenacetin.—La Propriété Industrielle.

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THE RENO INCLINED ELEVATOR.

The accompanying engraving shows the working of a new style of elevator which is being put to a practical test by the trustees of the Brooklyn Bridge. It is the invention of Mr. Jesse W. Reno, who, by way of introducing it to public and official notice, erected this same machine at Coney Island last September, where it carried over 75,000 people. The present test is being made at the New York end of the bridge, and, as will be seen from the engraving, the elevator is placed to the right of one of the stairways that lead to the station platform. The belt, or movable flooring, has an inclination of 25 degrees, the vertical lift being 7 feet, and it travels at the speed of 80 feet per minute.

Broadly stated, the device is an inclined belt conveyor, similar in its action to those which are used for raising baggage from a steamer's deck to the dock level. It consists of an endless belt, made up of transverse cast iron slats, which are 4 inches wide and 20 inches long, or sufficient to extend across the full width of the elevator. The top surface of the slats is provided with thin projecting parallel ribs, one inch in depth, which are spaced 1¼ inches apart and extend across the full width of the slat. When the slats are linked together to form a continuous belt, these ribs form continuous parallel lines, and as they are dished on their upper edges, they present a good foothold for the passengers. The slats are linked together at their ends, where they are provided with small wheels which roll upon the top flanges of two parallel inclined I beams. The weight of the passengers is thus carried directly by these beams, which serve to keep the flooring in true level. At each end the belt passes over a pair of sprocket wheels, the upper of which is carried on a driving shaft which is operated through worm gearing by the four horse power electric motor shown below the elevator.

Perhaps the most novel and ingenious feature is the provision which is made for connecting the movable with the stationary flooring. This is accomplished by finishing off the stationary floor line with steel comb shaped landings, which will be seen in the engraving at the foot of the elevator. The teeth of the comb project forward and upward between the above-mentioned ribs on the slats just where the belt leaves the lower sprocket wheels. These ribs keep rising between the teeth of the comb and so tend to lift the foot of the passenger and carry him along. As a matter of fact, the passenger naturally takes a step over the comb onto the moving floor. At the top of the elevator the ribs disappear below the comb landing, leaving the foot resting upon the stationary floor. How cleanly this transfer is effected is shown by the fact that a bundle of waste thrown upon the elevator is carried up and deposited upon the top landing.

The present elevator is of single width and is provided with one hand rail, which consists of an endless chain, which is driven by a sprocket wheel on the main driving shaft, at the same speed as the moving floor. It passes over two sprockets placed at a suitable height at each end of the elevator. The chain slides on a flat bar carried on stanchions, and it is kept in place by projecting pins at each link, which slide beneath projecting flanges formed on each side of the bar. A strip of leather covers the chain, and upon this is placed a thick rubber covering, which is riveted to the chain and extends down on each side of it, thus forming a good hand rail.

The capacity of an elevator 20 inches wide is 3,000 persons per hour; and every 20 inches additional width will accommodate another 3,000. It is estimated that ten to twelve feet width would accommodate the 15,000 people per hour that cross the bridge in the busiest hours of travel.

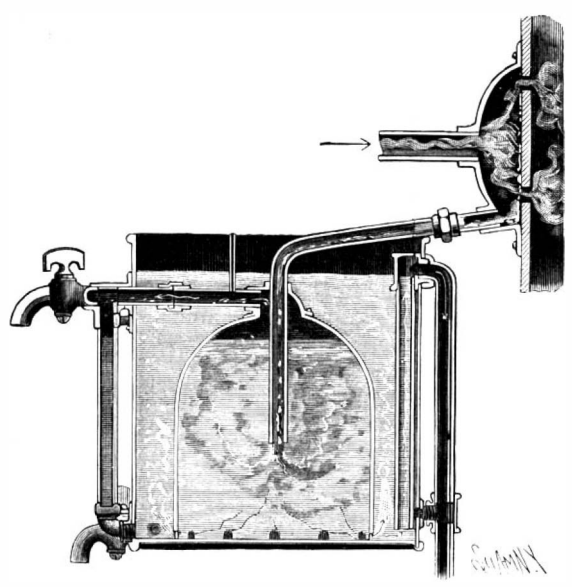
RENO INCLINED ELEVATOR AT THE BROOKLYN BRIDGE.

Nobel's Gift to Science.

A dispatch from Stockholm, dated January 2, states that under the terms of his will the property left by Alfred Nobel, the Swedish engineer and chemist, for a fund for the advancement of science will be realized upon, and the interest on the money will be divided equally into five prizes, to be awarded annually. Three of the prizes will be for the greatest discovery in physics, the greatest discovery in chemistry, and the greatest discovery in physiology or medicine. The fourth prize will be for the most notable literary contribution on physiology or medicine, and the fifth for the greatest achievement for the promotion of peace. The competition for these prizes will be open to the world. It is estimated that the fund will amount to nearly $10,000,000.

A NEW OIL SEPARATOR.

A recently patented device for separating the oil from the water of the exhaust steam of an engine is shown in the accompanying illustration, as it may be used in connection with the heater or condenser ordinarily employed. The exhaust pipe from the engine is tapped



SEPARATING THE OIL AND WATER OF THE EXHAUST.

into an external chamber of the heater, as shown at the right in the engraving, there being upper and lower openings into the heater from the chamber, and a pipe leading from the lower part of the chamber to the separator. The exhaust, striking the outer surface of the heater casing, will be somewhat condensed, and the water of condensation and the oil it contains will pass through the lower pipe to the separator. The latter consists of a flat bottomed tank, in the center of which rests a bottomless cone-shaped can, there being small notches in the lower edge of the wall of the can, affording passageways from its interior to the outside, and by means of an elbow pipe connection, the water of condensation is discharged at about the center of the can. A pipe in which is an upwardly projecting air vent leads from the top of the can to a faucet at the outside of the tank, and the interior of this pipe is connected with a glass gage whose lower end is connected with the interior of the tank near the bottom. Secured within the tank at the opposite side is a vertical, open-ended pipe, whose lower end reaches nearly to the bottom of the tank, and this pipe is connected near its upper end with an elbow pipe leading to a discharge connection. As may be readily seen, the oil in the water of condensation will naturally rise from the point of discharge within the cone-shaped can, more or less filling the top portion of the can, from which it may be drawn off by means of the faucet, while the water will pass downwardly and into the space surrounding the can, rising in the tank and in the pipe at one side until it reaches the level of the discharge connection near the top, the pressure of water within the tank, outside of the can, being always sufficient to force out the oil when the oil delivery faucet is opened. The relative height of the oil and water is always indicated by the gage, and the tank may be at any time emptied by means of a faucet near its bottom.

Vegetarianism—Its Effect Upon Nations.

In a recent communication to the Société d'Ethnographie, in Paris, M. Verrier treated of vegetarianism from the point of view of its moral and intellectual effect upon the nations who, either from choice or necessity, are to be classed as abstainers from animal food. While fully recognizing the dangers of a too abundant meat diet, as well as the advantages of purely vegetable nourishment, the speaker nevertheless felt constrained to come to the conclusion that nature intended man to be carnivorous. The physical constitution of the human race is so ordered that to insure the development of their higher qualities its members are of necessity compelled to become to a certain extent meat eaters. The attributes that make for dominion and progress are but imperfectly present among the eschewers of animal food, and hence vegetarianism causes the downfall of dynasties and leads to the enslavement of peoples. If, continued M. Verrier, the Hindoos, instead of following an absolutely vegetable regimen, had made use of meat in a rational manner, perhaps the British might not have found their subjugation such an easy matter. His argument was equally applicable to the Irish, who lived exclusively upon potatoes. As for the Japanese, with whom rice was formerly the staple food, the energetic nature of this people could not be cited in subversion of the rule laid down in his thesis. The reawakening of the conquerors at Port Arthur and the Yalu River was coincident with the establishment of a trade in butcher's meat throughout their archipelago.—Lancet.

Danger from Steel Buildings.

The true danger to be apprehended in regard to the modern office buildings of mixed steel and masonry construction is from rust. No one knows exactly how the metal in such structures is going to behave, for the reason that such combinations have never before been exposed in the same manner to the action of the elements. We know that iron buried in the heart of thick stone walls, laid in lime mortar, has remained unchanged for seven or eight centuries, presumably through the alkalinity of the lime, which has been known for ages as a powerful preventive of rust. Our high buildings are, however, built with cement instead of lime, and not much is known in regard to the action of cement on iron. Chemically, cement is much less alkaline than lime, and as it is insoluble in water, what alkalinity it possesses can hardly have much chemical effect on the metal. Its insolubility, however, makes walls built with it more impervious to water than those built with lime, and, if the steel structure is well grouted with cement, as is customary, there is reason to suppose that the metal, guarded from moisture by its impervious sheath, which, if it does not contribute alkali, at least contains no acid, may last uninjured for a very long period. Such experience as is available confirms this view, and although architects will watch with great anxiety for any signs of deterioration of metallic structures used in the new manner, as an indication which may assist in devising precautions against such action in future, they have certainly neither forgotten nor neglected anything that the present condition of knowledge affords in the way of information on the subject.—American Architect.

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Fortunate Inventions.

MANY LITTLE THINGS WHICH HAVE MADE PATENTEES RICH.

It is noticeable, remarks a Washington correspondent, that most of the big fortunes earned through patents have been gained by small things, such as would not be considered important by the casual observer. A country lass was made independent for life by the simple idea which is represented by the pasteboard compartment tray for packing eggs. She had to put up a great many eggs for market, and the loss by breakage was a serious matter. So she hit upon the notion of providing a separate compartment for each egg, and, inasmuch as pasteboard was cheap and the trays could easily be returned with the boxes that contained them, the problem was solved. It is a fact that people in rural parts invent few things. It was a Maine farmer, however, who patented copper tips for shoes, and it is reckoned that they were worth about half a million dollars to him. He had several boys who kicked out the toes of their shoes, and he found that copper tips made them last three times as long. Hence the idea.

One of the most successful inventors of small things was Crandall. He patented several puzzles that made money, but "Pigs in Clover" was his great hit in this line. At one time he was engaged in the business of making croquet sets, the lawn game being then at the height of its popularity. He devised a method of constructing the boxes, so that the parts were held together by groove and tongue fastenings instead of nails. One night he took home some of the waste pieces to his little girl, who was sick. She found such delight in playing with them and putting them together that her father conceived the idea of making similar blocks for the amusement of children. Such was the evolution of the well known Crandall building blocks.

Another very profitable toy was the invention of a bedridden boy. This was "Dancing Jim Crow," which for a long time was the rage. It is said to have yielded $75,000 in the first year it came out. By a simple bit of mechanism a darky was made to dance on a box. The celebrated "Fifteen Puzzle" was never patented; several inventors claimed to have originated it, and fortunes were gained by the sale of it. Most famous of all patented toys was the "return ball." It was sold for a cent, with rubber string and brass finger ring; yet the profit ran up to an enormous sum. The chameleon top and walking alligator brought fortunes to patentees. The roller skate was another very profitable invention, though it did not begin to make money until the patent had nearly run out, when the craze came.

Hundreds of thousands of dollars have been made by Dennison out of his shipping tags. The idea consists simply in a little ring of cardboard that re-enforces the tying hole and prevents the string from tearing out. A lot of money has been earned by the little brass clip fastening, patented a few years ago, by which sheets of paper are held together. Yet it is an exact copy of a contrivance in bronze that was used by the Romans more than twenty centuries ago. In fact, there are not a few modern inventions which are in reality merely reproductions of antique contrivances. One of these is the safety pin, which was commonly employed by the women of ancient Rome to fasten their dresses. Among the most profitable patents have been various little devices having relation to women's costume, such as the perspiration proof shield of rubber, the idea of substituting the quills of chicken and turkey feathers for whalebone in corsets, and the suspender garter. The last was sold outright for $50,000.

The ball and socket glove fastener is a Frenchman's idea, and it has made him rich. Another successful invention is the double ball clasp for pocketbooks and handbags. It is said that no sort of clasp can be popular unless it makes a noise when it catches. Only a few years ago a lucky man thought of putting a couple of little strips of cork on the nose pieces of eyeglasses to make them more comfortable. Nearly all eyeglasses nowadays have this improvement, and every pair pays a royalty to the inventor. The latest of the very profitable small inventions is the tin cap for beer bottles, which is taking the place of corks. It is cheaper than the cork, more convenient and keeps the beer better. Metal lemon squeezers are undesirable, because the juice of the fruit acts upon the metal and makes a poison. Not long ago somebody thought of making lemon squeezers of glass, and the idea was worth just $50,000 to him.

Tin cans are now made so that they can be opened by simply striking the top with a smart blow. As soon as he learned of the invention, Armour, the Chicago packer, ordered 500,000 of the cans, and the inventor is already independently wealthy. The automatic inkstand, which keeps an equal supply of ink always ready for the pen, is said to have earned $200,000. The "shading pen" has earned a sum even larger. Shoe buttons are no longer sewn on, but are applied with a metal fastener. This idea has been worth a big fortune. A new contrivance that promises to be very profitable is a whistle for bicycles, made on the principle of the siren fog whistle. There was $500,000 in the wooden shoe peg, but the inventor went insane just as wealth was pouring in upon him. Another gold producing patent was the inverted glass bell placed over gas jets to protect ceilings. Great sums have been earned by the rubber pencil tip, barbed wire for fences, and a contrivance for shaving ice. A "hump" on a hook to keep it from slipping out of the eye has made the proprietors of the contrivance millionaires.

One of the most valuable patents was the result of a dream. An engineer named Springer had been trying to devise an automatic lock which would brake a carriage going down hill, so that the driver would not have to get out, but might lock the brake by pulling his horse in. He dreamed that he was driving down a steep hill and had just such a lock on his wagon. He noticed exactly how it was constructed, and on waking he got up and sketched the details of the mechanism. He then went to bed again. Three days later he applied for a patent, which was granted. It yielded $75,000 the first year. Of the heaps of patents issued every week by the United States Patent Office only a very small percentage of them have any practical usefulness. But it is not always possible to judge before a thing has been tried. A few years ago a man thought of inclosing trees in canvas and filling the canvas with deadly gases for the purpose of destroying insects. He was considered a lunatic, but this method is now practiced on a great scale and with much success in California.

One man has patented a scheme for utilizing seaweeds as food, shredding them very fine, drying them, mixing them with sugar and cornstarch, and putting them up in tins. They are guaranteed to last indefinitely. Another inventor proposes to distill whisky from seaweeds. Yet another has a process for making flour from bananas, which are to be sliced, dried in hot air, and pulverized. This flour is nutritious and very cheap. Banana flour, by the way, is already manufactured on quite a large scale in Central America. A process has been patented for making a kind of wine out of over-ripe bananas, pressed and fermented. Sweet potato flour and desiccated mince pie are numbered among the original ideas on the files. An automatic tack driver is a hammer that contains a reservoir of tacks, so that there is no danger of banging one's thumb. Devices for cosmetic purposes are a finger taperer, a contrivance to hold back the ears, a spring to alter the lines of the mouth, a tongue cleaner and an antisnorer. A special novelty in false noses is attached to a spectacle frame, and imitation gold fillings are added to false teeth by burnishing gold foil upon them in spots, so as to make them look more natural.

Artificial hen's eggs are to be made in the laboratory, the whites being a mixture of sulphur, carbon and beef fat, and the yolks of beef blood, magnesia, etc., colored with chrome yellow. The shells are to be shaped with a blowpipe from a moist composition of lime and gypsum. Lockets of asbestos are intended to contain the addresses of people who travel on railways, for identification in case of collision and fire. One inventor proposes to stretch a cable the entire length of the Atlantic coast, some distance from the shore and anchored at intervals. Vessels dragging their anchors and in danger of being wrecked are expected to catch this cable and so save themselves. Another genius proposes that the government shall locate large rifled guns on dangerous parts of the coast, to be loaded with anchors and chains. On being discharged, the anchor unfolds and drops in the sea beyond the vessel, with the chain across her bows, so that the crew will only have to make the chain fast and ride out the storm in safety.

There is a process for preserving oysters in a batter of plaster of Paris. A special sort of cannon is designed to shoot water. It is a fact, by the way, that taxidermists use water cartridges for shooting humming birds, in order not to injure the plumage. One inventor proposes to construct a system of skeleton towers, on the tops of which bombs loaded with liquefied carbonic acid gas are to be exploded, the result being rapid evaporation and a chilling of the atmosphere. This is to be done when the weather is unendurably hot in summer. For the benefit of country folks visiting cities is a device to prevent blowing out the gas. The breath tilts a delicately balanced electrode and gives an alarm in the office of the hotel. There is a pneumatic sole for shoes to lessen the jar of walking, and a process has been patented for weaving textile fabrics from thread spun from peat. A talking watch contains a miniature phonograph and cries out the hour when the stem is pressed. The idea of punching pin holes in eggs to keep them fresh by supplying the contents with fresh air has actually been patented. When the hens go to roost, their weight on the perch may be utilized for actuating a mechanism which shuts the doors of the beehives on the farm, thus keeping out the night flying moths whose larvæ attack the honey and young bees. A washable paper, from which writing in ink may be removed after the lapse of any time, is made of rag pulp, glue and asbestos. The manufacture of it has been forbidden in Germany, because it might help fraud. Another patent is for making gold leaf so thin that four million sheets are required for an inch of thickness. This sort of gold leaf is deposited by electricity on sheets of copper and is quite transparent. Not least interesting is a process for extracting spider silk by machinery from living spiders. The common field spiders of the Sea Islands of South Carolina are preferred, a single one yielding 150 yards of the finest silk. Spider silk is superior in quality to that spun by the silkworm, but the difficulty hitherto has been to obtain it in sufficient quantities for commercial use.—Boston Journal of Commerce.

The Progress of Engineering.

Mr. Wolfe Barry, C.B., gave, says the English Electrical Review, some interesting statistics in his presidential address to the Institution of Civil Engineers, of the progress made by engineering during the present reign. These statistics, as given in the following table, indicate an extraordinary development in the agencies for distributing goods, and for the rapid transit of passengers, and a corresponding increase in the consumption per head of staple products:

	1837.	1896.
Population of kingdom	26,000,000	39,000,000
Miles of railways	1,000	21,000
Capital of railways	£30,000,000	£1,000,000,000
Speed of express trains (miles)	43 (1847)	60
Passengers	23,500,000 (1843)	1,000,000,000
Goods receipts	1,500,000 (1843)	44,000,000
Commercial navy of British empire (steamers) (tons)	70,000	6,500,000
Total (tons)	2,333,000	10,500,000
Tonnage of imports and exports	140,000,000	700,000,000
Coal mined (tons)	65,000,000	200,000,000
Coal per inhabitant (tons)	2·34	4·73
Pig iron made (tons)	3,000,000	7,500,000
Pig iron per inhabitant (ton)	0·1	0·2
Submarine cables (miles)	....	162,000
Death rate in London	24·4	19·5

The remarkable decrease in the death rate of London is no doubt partly due to improved sanitation, but probably also, in part, due to greater facilities for introducing fresh blood afforded by the improved means of transit. It is appalling to think where we shall be, at this rate of progress, in another sixty years. The check is likely to come, in the first place, from the exhaustion of our coal supply, which, as Dr. Hopkinson has recently pointed out, may be earlier than is usually supposed. Already the P. and O. steamers coal at Colombo with Australian coal; a small rise in the price of English coal would bring Australian coal to Aden, from which the steps are few to the home markets.

The Properties of Uranium Glass.

Glass containing uranium, to my mind the most beautiful of all glasses, was brought into prominent notice in the scientific world by the experiments of Stokes on fluorescence. Viewed by any light free from ultra violet light, uranium glass is almost or quite colorless, although some commercial samples containing silver or copper possess and show a tint under these circumstances, but, viewed by daylight or the electric arc, the magnificent green fluorescence or phosphorescence is seen. To the eye a room illuminated by incandescent gas light and one illuminated by the electric arc light are much the same, but a piece of uranium glass, which will not glow in the former, glows brightly in the latter; the incandescent gas light being very poor in ultra violet light, while the arc light is notably rich in ultra violet. Faraday, in lecturing at the Royal Institution in 1859 (Proceedings, ix, p. 160), made a curious mistake as to the fluorescence of uranium glass and similarly fluorescent bodies. He says: "This glow does not extend to all parts of the bodies, but is limited to the parts where the rays first enter the substances." As a matter of fact, the glow is produced in uranium glass all along the path of a pencil of light which enters, provided that light is ultra violet, or contains ultra violet, and if a pencil of such light is projected into a uranium glass lens or prism, the path of the pencil is clearly visible by the glow, and appears like a thick green smoke in a clear medium, affording splendid scope for optical demonstration at the lecture table. Uranium glass, which, like some of the vases now sold in the shops, is colored yellow or green, does not show this phenomenon like a pure uranium glass, but so minute is the amount of ultra violet light required to excite the fluorescence of uranium glass that even yellow samples will show the path of a pencil of sunlight as projected by a lens.—T. Bolas, in Amateur Photographer.

Examining the Heart by the Aid of the Roentgen Rays.

The London Electrical Review states that inasmuch as it has now become an accepted fact that the outlines of the heart, and to some extent its movement, can be seen with the aid of the Roentgen rays and fluoroscope, the former method of measuring the size of the heart by means of percussion is unsatisfactory, owing to the numerous personal factors which enter, and consequently the new method is welcomed. The method adopted by the writer is to place a piece of white paper on the back of a screen and trace the outlines of the heart on it with a metallic pen introduced between the screen and the chest, the point of the pen being readily seen, the outlines thus being traced without difficulty.

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CHANGES OF SPEED FOR BICYCLES.

In studying the rational gears for bicycles, we have reached the conclusion that for a cyclist of given strength the ideal gear would be that which, being modified according to the nature of the ground and its declivities, would cause the cyclist to work under constant conditions of angular velocity of the pedals, of pressure upon the pedals and of muscle. The progress made in the mechanics of the cycle will doubtless furnish a solution of this interesting problem ere long, but, in the interim, we may content ourselves with an intermediate solution that takes advantage of the elasticity of the human machine, from the standpoint of the three factors considered, viz., speed, pressure and strength, and simplify the problem by reducing the gears that a machine ought to present to two only, viz., a high one for smooth roads, even ground and feeble gradients, and a low one for steep hills and dangerous descents.

We propose in this article to examine the principal solutions of the problem in so far as they have received a material practical sanction, and as we have been permitted to see them or experiment with them. A word in the first place as to fruitless tentatives and incomplete solutions. At the Salon du Cycle of 1895 there figured two changes of speed with "shifting chain." The axis of the wheels and that of the pedals each carried two gear wheels over which a rather complicated mechanism caused the single chain to pass alternately, according as it was desired to obtain a high or a low speed. In order to cause the chain to pass from one train of gearings to the other, it was necessary to tauten the chain by jointing the axis of the pedals or by using a movable tightener. The system has not become popular, and the inventors have given up improving upon the first models constructed upon this principle.

A solution was afterward sought in the use of a double transmission with two pairs of gearings and two chains, only one of which operated at a time.

The Pegasus System.—The Pegasus bicycle, the essential parts of the change of speed of which are shown in Fig. 1, is founded upon this principle. In

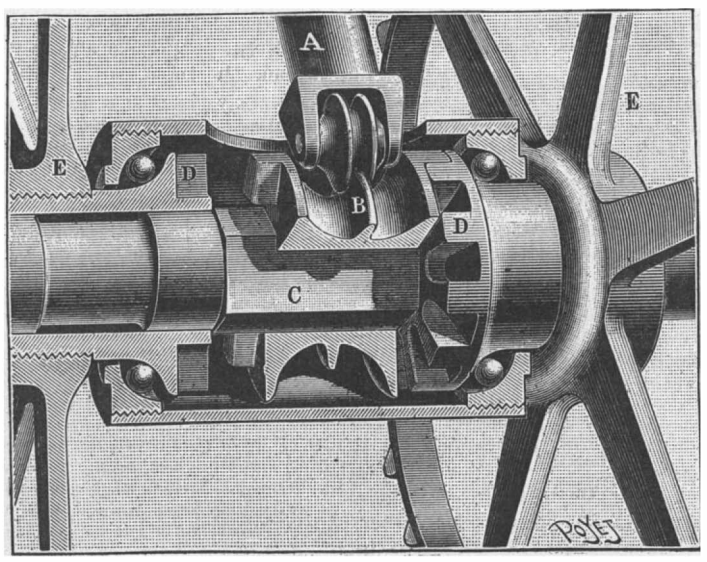

Fig. 1.—THE PEGASUS SYSTEM OF DOUBLE CHAIN CHANGE OF SPEED.

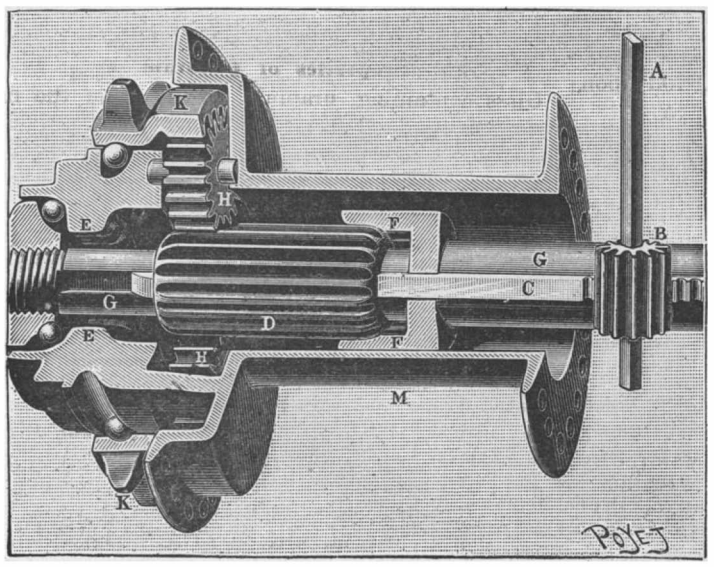

Fig. 2.—THE U AND R SYSTEM OF CHANGE OF SPEED.

this apparatus, the axis of the pedals carries in the center a hexagonal part, C, upon which slides a double grooved pulley, B, provided with teeth upon its two extreme lateral surfaces. This pulley is actuated through a lever, A, at the will of the cyclist, who, moving it to the right or left of its mean position, causes its teeth to engage with those at the sides of the hubs that carry along the wheels, E. These teeth, D, cause one or the other of the wheels, E, to gear with the axis of the pedals, according as the pulley, B, is moved to one side or the other. When one of the wheels is in gear the other is loose, and vice versa. In properly selecting the sprockets that are actuated by the two wheels, E, respectively, one has at his disposal two very unequal gears that are easily modified by simply changing the sprockets that the two wheels actuate. The change may be quickly effected, during a run, through the simple maneuver of a lever and without the cyclist getting off the machine. The use of two chains and two pairs of gear wheels is an inconvenience that is counterbalanced by the fact that, if one of the chains happens to break, it is possible to finish the journey by utilizing the second chain and throwing the corresponding wheel into gear. Mr. E. Fontaine has found here a simple and elegant solution of the problem, but the arrangement gives the machine a somewhat heavy aspect.

The systems that we are about to describe are based upon the principle of epicycloidal wheels. They are generally applied to the hub of the hind wheel, whose proportions and weight they increase to but an insignificant degree.

The U and R System.—This system, thus designated by the American Importing Company, consists essentially of a pinion, K (actuated by the chain), loose upon the axis of the hind wheel and with which mesh four small toothed wheels, H, whose axles are mounted upon the hub, M. Upon the fixed axis, G, slides a pinion, D, through the intermedium of the rack arm, C, actuated by the wheel, B, and axis, A. This pinion is capable of occupying three distinct positions, according as it is thrust wholly to the right (as shown in Fig. 2), toward the left or placed in an intermediate position.

The position represented in the figure corresponds to the reduction of speed. In this position the pinion, D, is rendered immovable in space, since its teeth mesh with those of the clutch, F, which is fastened to the fixed axis, G. The wheel, K, actuated by the chain, acts thus upon the hub, H, only through the intermedium of the wheels, H, engaging with the fixed pinion, D. The result is that at each entire revolution of the wheel, K, the hub, M, describes less than one revolution. If, for example, the wheel, K, is provided with 60 teeth and the pinion, D, with but 20, when K will have made one revolution, that is to say, will have moved forward by 60 teeth, the hub, M, will have moved forward but by $60-20=40$ teeth, say by two-thirds of the revolution. The ratio of the number of the respective teeth of the pinion, D, and the wheel, K, therefore regulates the reduction of the speed, which may, in principle, be of any degree. In practice, it varies between 25 and 35 per cent.

In the second position, the pinion, D, is pushed wholly to the left. It has left the clutch, F, and has come into gear with the piece, E, which is concentric with the axis and toothed internally. But the clutch, F, the wheels, H, and the hub are interdependent. Therefore, when the pinion, D, is pushed toward the left, the entire mechanism is blocked; that is to say, the wheel, K, the wheels, H, the piece, E, and the pinion, D, revolve together at the same angular velocity. Thus, in this position, there is no longer anything but an ordinary transmission. In order to pass abruptly from one position to the other, the extremities of the pinion, D, are rounded off, as are also the entrances of the toothed pieces, E and F. The piece, C, that carries along the pinion, D, does not enter the latter, but, for the entire length of the pinion, is reduced to the diameter of the fixed axis, G. The pinion is therefore loose upon the latter, which is fixed with respect to the frame when it is not held by the clutch, F.

In the intermediate position, in which the pinion, D, is not in gear with either E or F, all the parts of the mechanism become independent. The wheel, K, is capable of revolving while the hub is immovable, or inversely. It is necessary to avoid leaving the mechanism in this intermediate position, unless the machine is descending a long and gentle slope, and is provided with a brake that permits of a quick and certain stoppage before an obstacle that is unexpectedly met with.

The Cohendet System.—The Cohendet system is based upon a principle analogous to the one just described, but the mechanism is of a simpler and more compact form, and this permits of arranging it at will either upon the hind wheel or upon the axis of the pedals. We find here (Fig. 3) the internally toothed wheel, D, the small wheels, E, four in number, and the wheel, C, with which they gear. The method of actuating alone differs. When the machine is running at a normal speed, the toothed piece fixed to a disk that is fastened to the wheel, C, engages with the toothing, D, and renders the entire affair immovable. But if through the external maneuver of a combination of levers, not shown in the figure, we bear to the left upon the piece, A, we at the same time arrest the piece, C, and disengage the piece, A, from the teeth, D. The transmission of motion is no longer effected, except through the intermedium of the wheels, E, gearing with the fixed wheel, C. The ratio of the velocities depends upon the respective numbers of the internal teeth of D and the external ones of C.

The two systems that we have just described are reducers of speed, that is to say, the internal gearings enter into play only during a small fraction of the total time, at the moment of ascending hills, and under conditions in which the easing up introduced by the reduction of multiplication more than compensates for the loss of useful effect occasioned by the introduction of an intermediate mechanism.

Some inventors have solved the inverse problem and devised a multiplier of speed, that is to say, an apparatus in which the auxiliary mechanism acts during the entire time, and is suppressed at a slow speed. In such a combination there are numerous inconveniences that render it unnecessary to dwell upon such systems, which are not so perfect as the reducers of which we have just given a few examples.

The objections made to changes of speed are three in number: complication, weight and cost. The complication is merely apparent, since the present processes of mechanical construction and the rational use of ball bearings permit of making light of difficulties and of reducing friction to insignificant proportions. Weight likewise is only of secondary importance, and we are getting somewhat over the idea that it is necessary before everything else to construct a light bicycle, with tubes too slender and fragile, with pneumatic tires too small to surmount obstacles, with frames too paltry, with crank arms too short, and with saddles too uncomfortable, through their want of good seating capacity. As the result of our experience, we think that an increase of weight of about two pounds introduced into a machine along with a change of speed device is largely compensated for by the advantage that it gives of ascending all hills without fatigue, and especially of descending them. As for the cost, that is evidently the most serious objection, but it is not of a nature to intimidate a goodly number of tourists, who will quickly get back in pleasure the amount that a good change of speed now costs. And, then, the last word is not said, and perhaps the fourth Salon du Cycle now opening will reveal to us some marvels that, the case occurring, we shall present to our readers as the natural sequel of this preliminary study, which recapitulates the present state of the question.—E. Hospitalier, in La Nature.

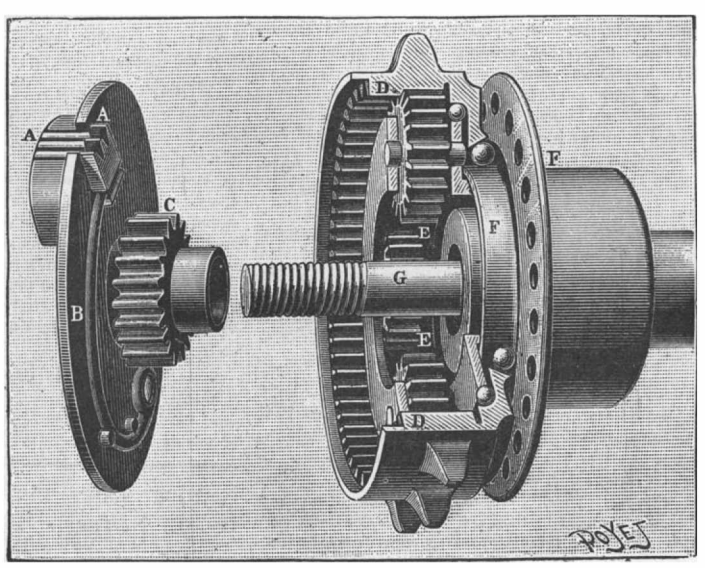

Fig. 3.—THE COHENDET SYSTEM OF CHANGE OF SPEED.

PROF. GILBERT DENNISON HARRIS is making a remarkable collection for Cornell University of the marine shells of the Eocene period in North America. He has finished work on only the first "stage" out of five or six. From this one "stage" alone, however, he has secured for the Cornell Museum specimens of every species previously known (about 100) and fifty more, hitherto unknown, which are consequently in no other museum than that at Cornell. Similar results may be expected from the remaining "stages," and great advancement of scientific knowledge in this field.

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RECENTLY PATENTED INVENTIONS.

Engineering.

MOVABLE DAM.—Benjamin F. Thomas, Louisa, Ky. A dam which may be raised and lowered at will, by means of a chain connected with a suitable motor, is provided by this invention. It is formed of A-shaped trestles, placed side by side on a suitable foundation across the stream, and hinged to journal boxes in the foundation, the upstream posts of the trestles forming the barrier, and when down lying one with another on the foundation, forming no obstruction to navigation. A continuous chain connects each trestle with raising and lowering machinery on the abutments at the side, and there is a footpath at the top above the proposed pool level. Openings near the tops of the trestles permit the passage of surplus water.

Electrical.

VOLTAGE REGULATOR FOR DYNAMOS.—Thomas M. Pusey, Kennet, Pa. To automatically control the voltage of a generator, and afford a practically even current through a circuit leading from the dynamo to the lamps or other devices, this inventor provides a simple mechanism comprising a rheostat in a shunt circuit wherein is a helix operating a balanced beam and serving as a contact closer, there being a rheostat operating motor with electrically operated brake for its armature, and connections between the armature and rheostat. The resistance of the beam may be regulated as desired by weights placed in pans.

TELEPHONE SWITCH BOX. — Wallace A. Houts, Parker, South Dakota, and Lars G. Nilson, Sioux City, Iowa. This invention provides a mechanism whereby, on hanging up the receiver, the parts will be automatically returned to a normal position, or one in which the call of the particular box will be automatically placed in circuit, the construction being such that any number of stations connected with a central office may be automatically connected to any one of the others. In the casing is an escapement wheel adapted to make and break circuit, a locking device, and a second wheel carrying a disk with telephone call numbers, there being a spring connection between the wheels, and means for automatically releasing the locking device.

Mining, Etc.

CONCENTRATING AND GRADING ORES.—William H. Coward, London, England. An apparatus is provided by this invention for concentrating, grading and classifying crushed ore, especially adapted for use with a roller grinding mill. The apparatus has a casing with openings in the opposite sides and a series of aligned tapering shells rigidly connected with intervening spaces, the shells being adapted to have a current of air passed through them, and to engage particles of ore carried in the current, causing the particles to drop through the spaces between the shells. The bottom of the casing is hopper-shaped and fitted with sliding doors at which the contents of each compartment may be withdrawn.

COAL JIG GATES.—Theodore E. Smith, Shamokin, Pa. To automatically operate the gates of coal jigs, for the discharge of slate or impurities accumulating at the bottom of the jig, this inventor has devised a mechanism consisting of a gate operating lever and a continuously reciprocating lever locked together by a bolt and latch in such way that they will be held locked together for a greater or less time according to the resistance offered by the material. The suspended and vertically reciprocated jig has perforations in its bottom for the passage of water used to clean the coal, and at one end is an outlet for the escape of the slate, etc., the gate, according to this improvement, being automatically opened when there has been sufficient accumulation to place tension on its movement.

Mechanical.

COMBINATION TAP AND DIE.—Stephen E. Pranke, Buchanan, Va. This is a tool adapted to quickly and simultaneously cut external and internal threads on spuds, pipes and other articles, the cutters being readily changed for work of smaller or larger diameters. A collet having a central opening at its rear end is shaped to fit a holder adapted to carry a tap, the front end of the collet having a bore into which extends the tap, and the collet rotating with the tap holder and carrying thread cutting chasers. The heels of the chasers abut against a collar screwing on the rear end of the collet, and when the chasers are adjusted they are locked in proper position by a locking collar.

NUT LOCK.—William C. Nones, Louisville, Ky. For locking nuts on axles, screw bolts, etc., this inventor has patented a device consisting of a metal plate having a slot to receive the bolt and a flange to embrace the nut, while a spring bar pivoted to the plate is so arranged as to close the slot and prevent the plate from becoming accidentally detached from the bolt and nut. A square-headed screw skein bolt is threaded in the opposite direction of the thread in the nut to be locked, and has parallel grooves in opposite sides of its head, to be used in combination with the plate.

MAKING SCRAPED BRASS.—Edward G. Smith, New York City. To efficiently scrape brass and adapt it to be driven into rollers to form the type for printing wall paper, this inventor has devised a machine in which two feed disks coact with revoluble cutters separated from each other, and whose cutting teeth have their oppositely arranged cutting edges beveled. Two adjustable guide blocks run beneath the feed disks and cutters and extend beyond them, forming guides proper through which the work passes.

SHEET FEEDER.—George B. Wurtz, Shreveport, La. To feed sheets of paper of like or different sizes rapidly and certainly to printing presses, paper folders, etc., this inventor has devised a mechanism comprising a suction bar and means to exhaust the air from it, the bar being mounted on an endless carrier which moves to and from a platform or table on which are the sheets to be fed. The suction bar has a facing or cushion of rubber or other elastic material, and apertures at suitable points, and the air is exhausted from it as it comes in contact with a sheet to be fed, the vacuum being broken when the bar reaches the point at which the sheet is to be delivered to the grippers.

PRINTER'S PAGE STICK. — Alaric G. Alrich, Lawrence, Kansas. To facilitate the making up of books, pamphlets, etc., the body of this device is made in the form of a steel rule, with lines or score marks on both sides corresponding to pica lines or other standard type measure, the rule having at its outer end an integral projecting portion or fixed jaw, and there being slidable on it a movable jaw. In the various score marks are openings and there is an opening in the movable jaw, which may be readily adjusted by means of a pin at any desired line mark on the rule, according to the number of lines to form a page, the device being very serviceable when a number of pages are to be made up to the same size. A clamping device with thumb piece holds the movable jaw on the body of the stick.

Agricultural.

CORN HARVESTER.—Orison C. Miller, Harveyville, Kansas. This is a machine designed to harvest two rows of corn while being drawn over a field, the stalks of corn being held within the machine prior to being cut and the cut corn falling against a support from which it may be readily removed by one or more operators. The machine has a dumping platform on which the shocks of corn may be readily set up and secured, that they may be delivered and left standing in the field. Two men are preferably employed to operate the machine.

Miscellaneous.

BICYCLE HOLDER.—Lewis K. Miller, Clarksburg, Mo. This is a light and compact device to be secured to the bicycle frame and carried out of the way of the rider, but so that it may be ready for use at all times on dismounting. The holder is attached to the lower diagonal and horizontal upper bar of the bicycle, and comprises a slotted sleeve in which slides a stem having at its lower end oppositely extending feet or legs. A pin on the stem projects through the slot in the sleeve, and the lower end of the slot is curved, whereby the feet of the holder are swung out to engage the ground on each side when the holder is lowered, and when it is raised the feet are swung in line with the frame so as not to project at the sides.

TYPEWRITING MACHINE. — Lawrence F. Urbanus, Chicago, Ill. This is designed to be a superior typewriter having the revoluble type wheel on which the type heads are mounted and means by which they may be moved to effect the impression, a simple and efficient feed mechanism being provided to move the carriage backward and forward. The key mechanism is so arranged that changes maybe made from upper to lower case, and in the line and letter spaces, with great facility and nicety, and a variable spacing mechanism is provided, so that absolutely exact printing may be done. The machine is designed to be operated at high speed and do the best work, the keys merely throwing the type into position for printing, the actual work of which is done by a rotating disk or cylinder, whereby all the letters are similarly and nicely printed.

HOSE COUPLING.—Joseph S. Blackburn, Salem, Ohio. This patent is for an improvement on formerly patented inventions of the same inventor, to prevent the buckling or bulging of the elastic sleeve serving to form a continuation of the bores of the male and female sections of the coupler, and also simplifying the construction of the jaws of the coupling and providing a better seat for the wrench adapted to open the jaws. In coupling the two sections are simply forced together, when the inner joining sleeve presents a solid wall throughout its entire length, and when the sections are united they have a substantially swivel movement on each other.

VEHICLE SEAT CANOPY COVER.—Alvanes G. Henery, Malta, O. According to this improvement, the seat is so made that a top or cover may be folded into it when not in use, means being provided for detachably connecting the sections of the canopy or top and holding its members one upon the other. The side braces are pivotally connected and provided with a device limiting their spread, and ribs are removably connected with the braces, while the seat comprises a skeleton base covered by the seating section, there being in the base a roller and a folding canopy having hinged connection with the base and being adapted to be stored therein.

MOIST COLORS. — August Sartorius, New York City. Colors for use in water color and gouache style are provided by this inventor in a special manner, in described proportions, with chief ingredients, as binding and dissolving media, of soft soap, mucilage, salicylic acid, glycerine and mirbane oil, the colors not containing any substances that require the application of heat for amalgamation. They may be readily applied in a uniform manner, dry quickly and yet permit of blending or the application of one color on top of another before fully dry. The proportion of color and mixing medium varies according to the nature of the color.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co. for 10 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

ROUGH NOTES ON POTTERY. By W. P. Jervis. Newark, N. J.: Published by the author. Profusely illustrated. Pp. 112. Price $1.

The author, without aiming to present a complete treatise, gives a large variety of most interesting facts regarding early makers of the best specimens and the development of the manufacture of fineware. The notes on early English pottery and on Staffordshire work are especially interesting, but the author briefly, and in an eclectic fashion, goes over the whole field, so far as may be done in the limited space. A short chapter is devoted to historical American earthenware, and another to ware made here and abroad for the American market.

TABLES FOR IRON ANALYSIS. By John A. Allen. First edition, first thousand. New York: John Wiley & Sons. London: Chapman & Hall, Limited. Pp. vii, 85. Price $3.

This excellent compendium of tables will be acceptable to a vast number of chemists, relieving them of the necessity of struggling with ratio and proportion and logarithms in converting their results into the requisite percentages. It gives very full and elaborate tables for converting the weights of precipitates or compounds as weighed or titrated in the course of analyses into the proper form for report. Thus we find no less than eight tables for converting CO_2 into C, useful in the determination of carbon in pig iron and steel, and this is an example of the system applied by the author to all the prominent constituents of commercial iron. After this come tables in a more concise shape for effecting requisite conversion of data. Although the book is stated to be for iron chemists, it will be a most useful companion for many others who work in the general field of inorganic analysis.

LEITFADEN FUR EISENHUTTEN-LABORATORIEN. Von A. Ledebur. Vierte, Neu Bearbeitete Auflage. Braunschweig: Druck und Verlag von Friedrich Vieweg und Sohn. 1895. Pp. 11.

We have already noted the contents of the tables for iron analysis. The present monograph treats of methods of analysis to be adopted, and for those conversant with German would form an excellent companion to the preceding work. It is very beautifully and clearly engraved, the illustrations being in the well known German style of wood cutting, which seems to lend itself peculiarly well to reproduction of laboratory apparatus.

A TEXT BOOK OF PLANE SURVEYING. By William G. Raymond, C.E. New York, Cincinnati, Chicago: American Book Company. Pp. 484. Price $3.

We feel that this book deserves considerable praise for its treatment of the subject of plane surveying. It is well up on recent practice, and as a special example of its method the portions devoted to the use of the level may be cited, to the adjustment of which nearly eight pages are devoted. In its pages may also be found treated plane table work, and the use of the slide rule, planimeter and stadia measurements are excellently given. Full tables and numerous examples of work in the way both of underground surveying and of general topography are also given.

CATALOGUE OF THE PUBLIC DOCUMENTS OF THE FIFTY-THIRD CONGRESS. And of all departments of the government of the United States for the period from March 4, 1893, to June 30, 1895. (Being the "Comprehensive Index" provided for by the act approved January 12, 1895.) Prepared under the supervision of the superintendent of documents, Government Printing Office. Washington: Government Printing Office. 1896. Pp. 638.

To those interested in knowing what the United States Congress does with its time, what constitutes the contents of the many reports, as prepared by the federal government, and what work is being done in its scientific departments, this index will be of great value. It presents in consecutive index form the topics of the public departments; the indexing running consecutively from beginning to end, there being, very sensibly, no subdivisions attempted, beyond the data and the list of government officers to whom the indexes are to be credited.

MECHANICAL DRAWING. By Charles F. Jackson. Philadelphia: J. B. Lippincott Company. Pp. 63, 20 plates. Price $1.50.

A work for the use of students in architectural as well as mechanical drawing is here presented by a teacher of many years' experience. The subject of projections is fully treated, difficult terms are avoided as far as possible, and the explanations are carefully and concisely made.

BLOCK AND INTERLOCKING SIGNALS. By W. H. Elliott. New York: Locomotive Engineering. Pp. 277.

This is a republication in book form of a series of interesting articles originally published serially, written by one who has had practical acquaintance with the subject as having had charge of this bureau on the Chicago, Milwaukee, and St. Paul Railway. What signals are for, what they do, and how they do it, will all be found answered in these pages, including telegraph systems, manual systems, and automatic electric systems, together with methods of operation and rules.

DICTIONARY OF THE COAL TAR COLORS. By George H. Hurst, F.C.S. London: Heywood & Company. Pp. 212. Price $3.25.

That it should require a large book to simply describe and classify the different colors made from what was a waste product twenty years ago, and these colors now the most important in the employ of the textile colorist, is one of the most striking of the many illustrations of our progress in applied chemistry. This book has reached its second edition. It gives the chemical composition of the different colors, formula, method of making, and date of introduction, with the properties and uses of the colors. It gives also a list of the leading foreign coal tar color makers.

Commencing with January, 1897, the Street Railway Review will issue a special foreign edition, which in size and quality of matter, illustrations and general attractiveness will be fully equal to their present home edition. As usual, the Review will be the pioneer in this new departure, but no expense or effort will be spared to make it deserve the same recognition abroad which it has earned at home.

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Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(7082) R. W. L. asks for directions for making an electromagnet for working telegraph sounder on an outdoor line of about 200 feet (metallic circuit). What number insulated wire should be used, and how much? How many cells of gravity batteries will it take to work it? A. For cores use two bundles of iron wire two inches long and about ½ inch in diameter. Wind with No. 20-24 wire to an inch or more in thickness. As yoke you may use a bar of iron, or simply bend six inch lengths of wire into a U, and dispense with yoke. Two cells of gravity battery should work it.

(7083) J. W. asks: 1. Is electric lighting with batteries successful? A. No; except with storage batteries. 2. What kind of cells and how many would it take to run four 16 candle power lamps four hours per day? A. Ten cells storage battery for low voltage lamps. 3. Which would be the cheaper light—four 16 candle power lamps from batteries or coal oil lamps to light a room 24×36 feet? Oil at 35 cents per gallon. A. The coal oil lamp is about the cheapest of the ordinary illuminants.

(7084) M. S. K. says: A few days ago I had occasion to make some standard resistance coils. I found that without exception a certain length of wire had more resistance when coiled on a wooden spool than it had before it was so coiled. Will you please give me an explanation through the columns of the SCIENTIFIC AMERICAN? A. Any disturbance of the molecular condition of wire changes its resistance. If it hardens it, the resistance generally may be assumed to increase, and bending a wire operates to do this

(7085) F. S. G. says: Please tell me what kind of glass is best for Leyden jars and whether they can be charged with an induction coil. If so, how? A. A good quality of hard glass is the best for Leyden jars. Some glass is so inferior as to be quite worthless. To charge, connect the inner coating with one terminal and the outer coating with the other terminal. Take care of shocks. Induction coil experiments are described in our SUPPLEMENT, No. 166

(7086) T. W. B. says: I wish to make a 20 ohm telegraph sounder; will you please inform me, in your paper, of how many feet of what kind of wire will give the most satisfactory results? A. Use No. 28 to No. 30 wire.

Approximate length,	No 28.....	300 feet.
"	" No. 29.....	.....200 "
"	" No. 30.....	100 "

(7087) J. B. M. asks: What is the resistance of a gallon gravity Bunsen, Fuller, and Leclanche battery? A. For the Leclanche battery allow 1 ohm, for the gravity 4 ohms, for the others ¼ ohm, all subject to large variations. 2. How long a spark is required to make a good X ray? A. Two inches is a good length.

(7088) J. D. asks (1) for a solution to keep photograph proofs from fading. A. Dip the proof in a solution of hyposulphite of soda 20 grains, dissolved in 5 ounces of water for ten minutes, then wash in changing water for two hours. 2. Also mention where I can get unmounted photographs of actresses. A. For pictures of actresses consult your local book or stationery storekeepers.

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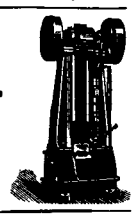

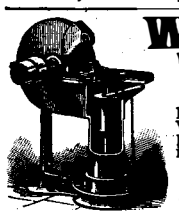

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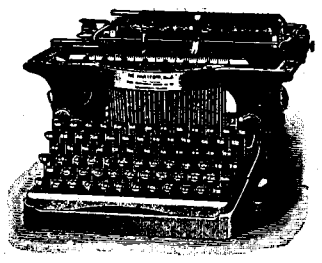

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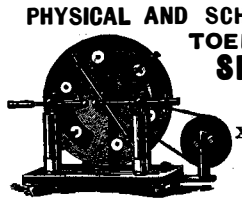

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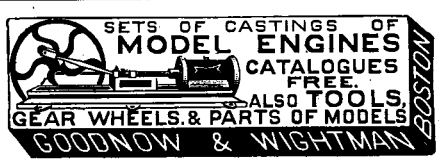

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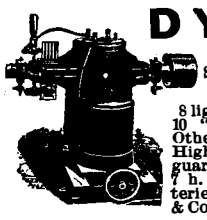

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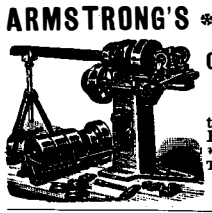

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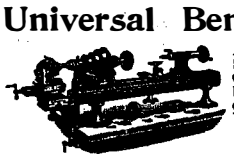

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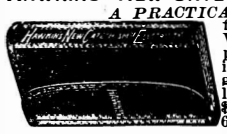

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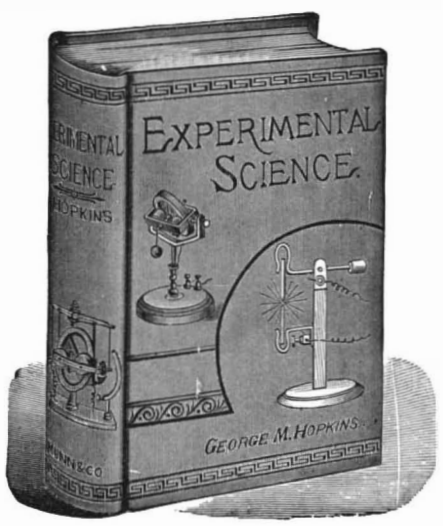

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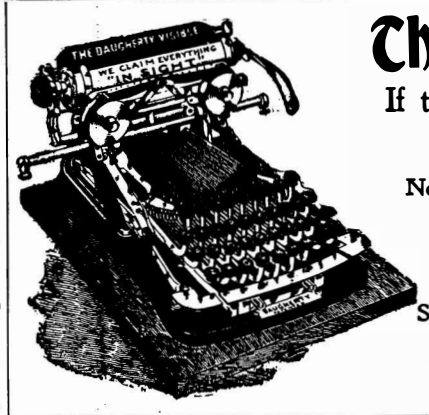

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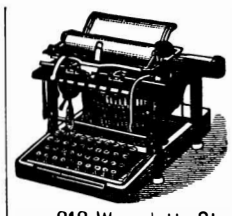

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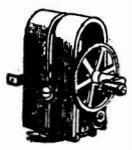

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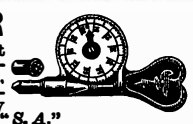

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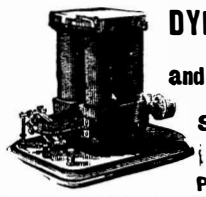

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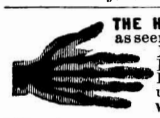

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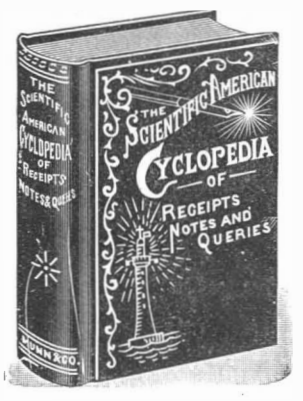

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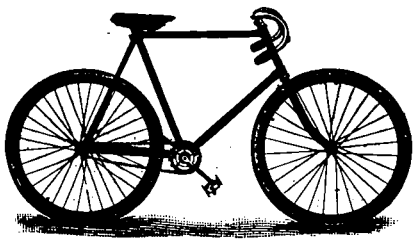

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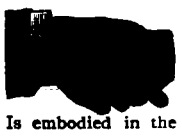

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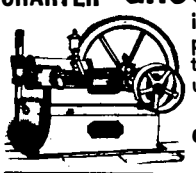

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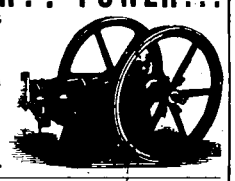

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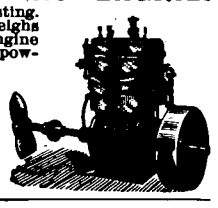

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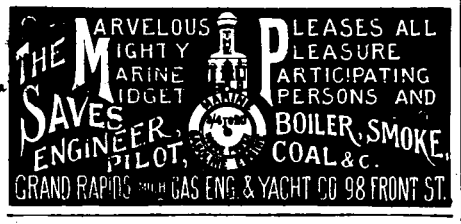
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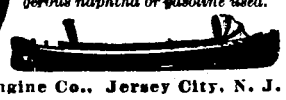

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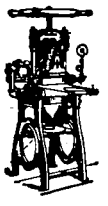

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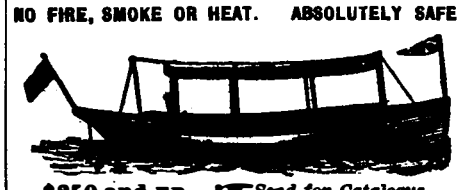

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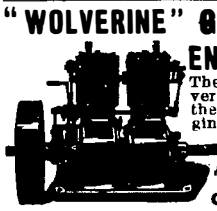

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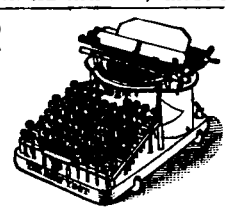

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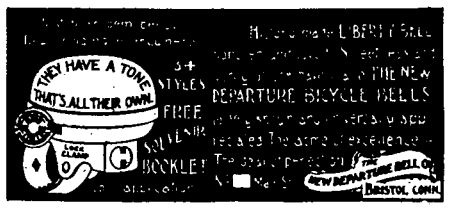
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